

Memo

August 2025

TO: Erica Perez, Chair, EMC

FR: Puako for Reefs, Karen Anderson, President (Karen.Anderson@puako4reefs.org)

RE: Puako as a Model for Community-Initiated Cesspool Conversions
Proposal to EMC and Cesspool Conversion Task Force

The Problem: the Lack of a Model for Community-Initiated Solutions

In response to the State's 2050 mandate to eliminate all cesspools, there are three choices:

- Every homeowner on their own;
- Wait for the County to implement a plan according to their priorities;
- Communities organize to partner with the County.

In certain areas, replacing a cesspool with a septic system or aerobic treatment unit (ATU) may be an appropriate solution in which case every homeowner could carry out this solution on their own. However, where the only appropriate solution is a sewer system due to small lot sizes or coastal areas where even septic or ATU systems can still contaminate the waters, either the County or the community must initiate this complex solution. Waiting for the County may be too late to save coral reefs that are sensitive to wastewater effluent. For example, several scientific studies have documented that the Puako reef could still recover if the stress from wastewater effluent was removed, but there is about a 10-year window to act before the damage becomes irreversible. This urgency prompted the Puako community to take action.

Over the past 10 years, the Puakō community has partnered with three successive County administrations in efforts to install a sewer system. Local residents have donated more than \$3 million to support this work. Agreements were reached under two administrations, but ultimately the project stalled.

The root problem is not a lack of support, but a lack of process: **the County does not currently have a pathway for community-initiated sewer projects**. The only pathway offered by the County for a CFD is a process designed for developers that requires an initial deposit of \$75,000 (see Exhibit A: CFD Guidelines).

Puako as a Model

Puakō is not alone. Other communities in the County face similar circumstances, but Puakō is the most advanced in planning and preparedness. This presents an opportunity. By using

Puakō as a pilot project, the County can establish a clear, replicable framework to guide future projects across the island. With the support of the EMC and Cesspool Conversion Task Force, there will be a stronger voice calling out the need for a community-initiated model.

Puako has formed a nonprofit 501(c)(3) corporation, Puako for Reefs (PFR), to spearhead the effort. Through the tax-deductible donations received, PFR has retained consultants for the planning phase that has set forth the project's direction as follows:

- Low-pressure sewer system, as significantly more cost-effective than a gravity system;
- Connection to an existing private wastewater treatment plant at neighboring Mauna Lani Resort, as significantly more cost-effective than building a new plant;
- Financing this system through a Community Facilities District (CFD), as more appropriate than the more familiar Improvement District (ID);
- Applying for a USDA loan on behalf of the County that has a below-market interest rate and long amortization period, that would be repaid through the CFD special taxes.

Some or all of the above may apply to other communities, who would then share an interest in the threshold questions raised by this Puako model and presented to the County through a preliminary CFD Application (see Exhibit B: Draft CFD Application with Proposed Amendments to the Deposit & Reimbursement Agreement):

- In what circumstances is a CFD more appropriate than an ID?
- How can a community initiate a CFD since the County's guidelines are developer-oriented?
- Will the County accept and operate a low-pressure system with homeowner-maintained components?
- Can a County sewer system legally connect to a private WWTP?
- Can private property components be financed through a CFD?
- Does the County have any concerns to be the borrower for a USDA loan?
- How can the County structure interim financing until the USDA loan closes?
- What special tax formulas make CFD costs equitable and affordable?
- How should the revolving fund be setup and administered?
- What public or private sources are available to help pay for the project in recognition that in some cases there are benefits to the general public who would enjoy the cleaner nearshore waters?
- How do you effectively educate and engage the community who will have to shoulder long-term payments as their fair share of the costs?

The attached Exhibit C is a checklist framework for this Model that would evolve as questions are answered and more details become known.

Role of the EMC and Task Force in Supporting this Model

PFR requests that the EMC and the Task Force jointly sponsor this Model. The sponsor's role would be as follows:

- Monitor PFR's progress (or delays) through regularly scheduled progress reports from PFR;
- Testify in support of pertinent County Council action as appropriate;
- Advocate through support letters or other appropriate means when issues arise;
- Work towards institutionalizing the process based on the lessons learned from this Model.

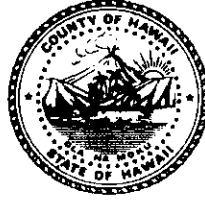
Conclusion

The reefs are collapsing. The deadline is quickly approaching. Many communities are concerned. This model offers the County a chance to lead and establish a pathway for communities to be an active part of the solution.

We are available to make a presentation and/or provide more information. We look forward to hear from you.

EXHIBIT A: CFD GUIDELINES

Harry Kim
Mayor



Dixie Kaetsu
Managing Director

Barbara Kossow
Deputy Managing Director

County of Hawaii

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July 20, 2007

Pete Hoffmann, Chairman and
Members of the Hawai'i County Council
Hawai'i County Council
25 Aupuni Street
Hilo, HI 96720

Dear Chairman Hoffmann and Council Members:

Chapter 32 of the Hawai'i County Code ("Chapter 32"), entitled the "Community Facilities Districts Code," authorizes the County of Hawai'i (the "County") to establish community facilities districts ("CFDs") within the County for the purpose of financing the purchase, construction, installation, expansion, improvement or rehabilitation of special improvements (as defined in Chapter 32). The establishment of a CFD is subject to satisfaction of various substantive and procedural requirements specified in Chapter 32.

The County recognizes that the requirements of Chapter 32 must be applied in a fair and consistent manner based on fair and consistent standards. The purpose of these administrative guidelines is to establish the procedures and standards to be applied by the Administration in evaluating proposed CFDs and CFD bond issues. Amendments to the guidelines will be made from time to time, as necessary and appropriate.

The procedures and standards set forth in these guidelines will apply generally to CFDs proposed by the County itself and those proposed by private owners. However, the application process will differ for CFDs proposed by private owners. In addition, to the extent applicable in the case of CFDs proposed by the County, the availability of County funding to defray costs and the degree of County oversight over construction of the special improvements will be taken into account in addressing various standards set forth in these guidelines.

In each and every circumstance, the decision as to whether or not the County will establish a CFD under Chapter 32 will be made solely by the County Council. Nothing contained within the guidelines shall be construed as obligating the County to establish a CFD in any circumstance or as granting to any person any right to have the County establish a CFD in any circumstance.

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Ref. Date JUL 31 2007

Honorable Pete Hoffmann, Chairman
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The administrative guidelines are organized into two basic parts:

Part I relates to the CFD Review Committee that has been created to administer the review process for proposed CFDs, and the review process to be administered by the Committee, including provisions for the initiation of the review process, the initial and subsequent reviews (if necessary) to be conducted by the Committee and the County's retention of special consultants for advice and assistance in connection with the consideration and formation of proposed CFDs.

Part II relates to the criteria to be applied by the Committee in its review of proposed CFDs, including a description of special improvements eligible for CFD funding, the types of public benefits that these special improvements should be expected to provide, the funding priorities of different types of special improvements, the special taxes to be imposed, the appraisals and market absorption analyses required to support the feasibility of the CFDs, relevant structural considerations for CFD bond issues, and disclosure obligations to CFD bond investors and purchasers of CFD properties.

Staff from the Department of Finance will be happy to discuss these Guidelines in greater detail when it is reviewed by the County Council. Should you have any questions before that, please contact Finance Director, William Takaba, at your convenience.

Aloha,



f Harry Kim, Mayor

cc: William Takaba

COUNTY OF HAWAI‘I

ADMINISTRATIVE GUIDELINES FOR EVALUATION OF PROPOSED COMMUNITY FACILITIES DISTRICTS

Chapter 32 of the Hawai‘i County Code ("Chapter 32"), entitled the "Community Facilities Districts Code," authorizes the County of Hawai‘i (the "County") to establish community facilities districts ("CFDs") within the County for the purpose of financing the purchase, construction, installation, expansion, improvement or rehabilitation of special improvements (as defined in Chapter 32). The establishment of a CFD is subject to satisfaction of various substantive and procedural requirements specified in Chapter 32.

The County recognizes that the requirements of Chapter 32 must be applied in a fair and consistent manner based on fair and consistent standards. The purpose of these administrative guidelines is to establish the procedures and standards to be applied by the Administration in evaluating proposed CFDs and CFD bond issues.

The procedures and standards set forth in these guidelines will apply generally to CFDs proposed by the County itself and those proposed by private owners. However, the application process will differ for CFDs proposed by private owners (as discussed herein). In addition, to the extent applicable in the case of CFDs proposed by the County, the availability of County funding to defray costs and the degree of County oversight over construction of the special improvements will be taken into account in addressing various standards set forth in these guidelines.

In each and every circumstance, the decision as to whether or not the County will establish a CFD under Chapter 32 will be made solely by the County. Nothing contained herein shall be construed as obligating the County to establish a CFD in any circumstance or as granting to any person any right to have the County establish a CFD in any circumstance.

These administrative guidelines are organized into two basic parts:

Part I: relates to the CFD Review Committee that has been created to administer the review process for proposed CFDs, and the review process to be administered by the Committee, including provisions for the initiation of the review process, the initial and subsequent reviews (if necessary) to be conducted by the Committee and the County's retention of special consultants for advice and

assistance in connection with the consideration and formation of proposed CFDs. Attached as Exhibits A and B hereto are the current forms of the CFD Application and the Deposit and Reimbursement Agreement described herein with respect to the County's CFD process.

Part II: relates to the criteria to be applied by the Committee in its review of proposed CFDs, including a description of special improvements eligible for CFD funding, the types of public benefits that these special improvements should be expected to provide, the funding priorities of different types of special improvements, the special taxes to be imposed, the appraisals and market absorption analyses required to support the feasibility of the CFDs, relevant structural considerations for CFD bond issues, and disclosure obligations to CFD bond investors and purchasers of CFD properties.

**PART I: THE CFD REVIEW COMMITTEE
AND THE CFD REVIEW PROCESS**

A. THE CFD REVIEW COMMITTEE

Each proposed CFD shall be evaluated by the Administration's Community Facilities District Review Committee (the "Committee"), which shall include the following officials or their respective designees: the Managing Director; the Finance Director; the Planning Director; the Director of Public Works; and the Corporation Counsel. The Committee shall be chaired by the Finance Director or his/her designee.

The Committee shall review each proposed CFD for compliance with the requirements of Chapter 32 and these administrative guidelines. Each proposed CFD will be reviewed initially prior to consideration by the County Council of the Resolution of Intention (the "ROI") authorizing the institution of proceedings for the formation of the CFD, and again if necessary prior to consideration by the County Council of the Ordinance of Formation providing for the establishment of the CFD (the "Ordinance of Formation") and the Bond Ordinance providing for the issuance of bonds to finance special improvements relating to the CFD (the "Bond Ordinance").

B. INITIATION OF CFD REVIEW PROCESS¹

1. CFD Application.

Each developer/landowner proposing the formation of a CFD (the "Applicant") will be required to submit a completed Application for CFD Financing (the "CFD Application") to the Department of Finance. The current form of CFD Application is attached as Exhibit A hereto. Submission of the completed CFD Application will be required before the Applicant petitions the Council to commence proceedings for formation of the proposed CFD, with sufficient time allowed for the Committee to conduct its initial review of the proposed CFD.

2. Deposit of Funds.

In addition, in connection with the processing of a CFD Application and as a condition to the taking of any action on the Applicant's petition, the Applicant will be required to deposit funds with the County to cover the costs and expenses incurred by the County in connection with its consideration and implementation of the proposed CFD, including a reasonable charge for administrative staff time, fees of the County's special consultants and out-of-pocket expenses of

¹ The application procedure outlined in this Section applies specifically to CFD proceedings commenced upon petition by a developer/landowner. In the case of proceedings commenced by the Council on its own initiative, the Committee will work cooperatively with the Council to develop and obtain the necessary information for the Committee's review of the proposed CFD.

the County relating to the proposed CFD. The deposit will be made pursuant to a Deposit and Reimbursement Agreement between the County and the Applicant. The current form of Deposit and Reimbursement Agreement is attached as Exhibit B hereto.

The County will generally suggest the initial deposit to be at least \$75,000, and may require a higher amount depending on the circumstances. Pursuant to the Deposit and Reimbursement Agreement, the deposit will be used by the County to pay its costs and expenses relating to the proposed CFD and is subject to replenishment by the Applicant on demand of the County if the balance falls below a specified minimum level. The use of the deposit shall in no way be construed as obligating the County to form the proposed CFD or to issue CFD bonds. Upon termination of the CFD proceedings or issuance of bonds for the CFD (as applicable), and after payment of all of the County's costs and expenses relating to the CFD, any remaining portion of the deposit will be returned to the Applicant.

C. THE CFD REVIEW PROCESS

1. Initial Review Process.

The Committee will conduct an initial review process for each proposed CFD prior to consideration of the ROI for the CFD by the County Council. In the case of CFD proceedings to be commenced by petition of a developer/landowner, this initial review process will be conducted upon the Committee's receipt of the completed CFD Application for the proposed CFD, and the Applicant's petition to Council should not be submitted until completion of this review process. This initial review process will focus primarily on the following areas:

- a. To confirm that the information provided in the CFD Application is sufficiently complete and responsive to the requirements of Chapter 32 and the review criteria set forth herein;
- b. To identify and evaluate the public benefits and funding priorities associated with the special improvements included in the proposed CFD;
- c. To review the proposed forms of the Applicant's petition to Council and ROI, including the legislative findings and determinations to be made pursuant to the ROI;
- d. To review the proposed rate and method of apportionment (the "RMA") for the special taxes to be imposed within the proposed CFD, as specified in the RMA report prepared by the County's special tax consultant;
- e. To review relevant components of the proposed CFD for conformity with the guidelines set forth herein and to identify and address any potential difficulties that may be encountered at later stages in the CFD process (e.g., at the time of the County's consideration of the Ordinance of Formation or Bond Ordinance, or at the time of any subsequent offering of CFD bonds for the proposed CFD);

2. Additional Discretionary Review.

To the extent deemed necessary or appropriate by the Committee in its discretion, each proposed CFD will be subject to further review by the Committee, prior to submission of the Ordinance of Formation and the Bond Ordinance to the County Council, for the following purposes:

- a. To review the principal components of the CFD and CFD bonds to be authorized in relation to the requirements of Chapter 32 and the review criteria set forth herein, to the extent that such matters were not fully addressed in the initial review process; and
- b. If applicable, to consider any significant changes in relevant facts or circumstances subsequent to the completion of the initial review process.

D. CONSULTANTS

The Committee may seek and rely upon the advice of special consultants retained by the County in connection with the Committee's review of proposed CFDs. All such special consultants shall be independent of the Applicant. The selection of such special consultants will be made pursuant to the County's consultant selection procedures for bond issues (which are applicable to CFD bonds). Accordingly, the selection of special consultants will be made solely by the County in its discretion.

Typically, County will retain the following special consultants in connection with the formation of CFDs and issuance of CFD bond issues:

1. Special Tax Consultant.

A special tax consultant will be retained by the County to collect and analyze relevant information on the tax base in the CFD, advise the County regarding appropriate tax calculation and allocation methods to support the costs of the proposed special improvements and related costs of the CFD and the CFD bonds, and prepare the RMA reflecting the tax calculation and allocation methods to be implemented. (See Part II.B for a discussion of RMAs.)

2. Appraiser.

An appraiser will be retained by the County to determine the value of the properties within the CFD, and to prepare the MAI appraisal report(s) on such value for purposes of Chapter 32, Section 32-18, and for bond marketing purposes. At its discretion, the County may permit the appraisal to be prepared by an appraiser not appointed by the County, but the County reserves the right in such instances to retain its own appraiser to perform an independent review of the appraisal. (See Part II.C for a discussion of relevant appraisal criteria.)

3. Market Absorption Consultant.

In most cases, the County will retain a market absorption consultant to analyze and report on the rate at which the properties in the CFD which are subject to a special tax are expected to be sold or leased to end users. As necessary, the market absorption consultant will also provide

relevant information to the appraiser for purposes of the CFD appraisals. (See Part II.D for a discussion of the market absorption study.)

4. Bond Underwriter.

In most cases, the County will sell CFD bonds in a negotiated sale process. In connection with such sales, the County will retain a bond underwriter to assist in the structuring of the bond issue, to market the bonds to potential investors and to purchase the bonds from the County for reoffering to investors. (See Part II.F for a discussion of considerations regarding the structure of CFD bond issues.) Depending on the size and complexity of the offering, the County may retain a team of two or more underwriting firms, in which case one firm will be designated as the lead underwriter.

The bond underwriter will be represented by legal counsel for the purpose, among others, of preparing the offering and underwriting documents for the CFD bond issue. The underwriter will select its own legal counsel, but the underwriter will be expected to consult with the County in making this selection so as to help avoid potential conflicts and promote the formation of an effective financing team.

5. Special Counsel.

The County will retain bond counsel for purposes of: preparing the ROI, Ordinance of Formation, Bond Ordinance and bond financing documents; assisting the County in the review of the RMA, appraisals, market absorption study, bond purchase contract, official statement and other documents relating to the formation of the CFD and the offering and sale of bonds for the CFD; and providing legal advice regarding the foregoing. In appropriate cases, special tax counsel will also be retained to provide tax advice regarding the CFD bonds in conjunction with the services of bond counsel.

In connection with the issuance of CFD bonds, the County may also retain disclosure counsel for the purpose of preparing the official statement or other offering document to be circulated in connection with the marketing of the bonds.

6. Financial Advisor.

In most cases, the County will also retain a financial advisor to provide financial analysis and advice regarding the formation of the CFD and the structure, offer and issuance of the CFD bonds, and to assist in coordinating the respective responsibilities of the County and its special consultants in connection with the foregoing.

7. Other Appointments.

In addition to the foregoing special consultants, the County will also select other outside service providers in connection with CFD bond issues, including the bond trustee, credit enhancement provider and official statement printer.

PART II: CRITERIA FOR REVIEW OF CFD PROPOSALS

A. ELIGIBLE IMPROVEMENTS

1. Eligible Special Improvements Generally.

Special improvements eligible for funding under Chapter 32 include infrastructure facilities that serve and provide benefits to the public in connection with the formation of a CFD. Such facilities are required to have an estimated useful life of five years or more. Privately-owned facilities may be eligible for financing under Chapter 32 if the County Council determines that they serve a public purpose.²

Eligible special improvements may include, but are not limited to, the following types of facilities and improvements:

- a. Streets, roads, highways, pedestrian malls, sidewalks or alleyways, including but not limited to, grading, paving or otherwise improving the foregoing;
- b. Public parking facilities;
- c. Lighting systems, including but not limited to traffic signals, for any public right-of-way;
- d. Local park, recreation, child care, parkway and open-space facilities;
- e. Elementary, secondary, vocational and higher education school sites and facilities;
- f. Libraries, museums or other cultural facilities;
- g. The undergrounding of natural gas pipeline facilities, telephone lines, facilities for the transmission or distribution of electrical energy, cable television lines and other utility facilities, subject to the further provisions of Chapter 32, Section 32-7(g);
- h. Water systems;
- i. Police, criminal justice (including but not limited to jails and courthouses), fire suppression (including but not limited to fire stations) and paramedic facilities;
- j. Wastewater, storm damage, sewage removal or treatment, or solid waste disposal, recycling or resource recovery systems or facilities;
- k. Transit or transportation systems;

² It should be noted that federal tax laws impose limits on tax-exempt bonds that can be issued to finance privately-owned infrastructure facilities as part of a CFD. Therefore, it may be necessary to issue taxable bonds to finance such facilities. Chapter 32 permits the issuance of both tax-exempt and taxable bonds for CFDs.

- l. Telecommunications systems; and
- m. Any other facilities which the County is authorized by law to contribute revenue to, or construct, own, maintain or operate.

2. Required Public Benefits.

Chapter 32, Section 32-18, provides in relevant part that: "No district shall be established unless the council finds that ... such approval is in the public interest." In connection with each CFD proposal, this public interest requirement will be evaluated in terms of the benefits to the public that will be provided by the special improvements to be funded through the formation of the CFD and issuance of CFD Bonds. In view of the financial benefits to be realized by developers and owners of properties within the boundaries of the CFD, the County will require demonstration of meaningful types and levels of public benefits.

There is no single standard by which public benefits produced by CFDs can be measured. Therefore, each Applicant should be expected to demonstrate how and to what extent specific improvements included in its proposed CFD, and the CFD as a whole, will produce meaningful benefits to the public. Consideration will be given to the following types of factors:

a. Regional Benefits.

Special improvements that provide regional benefits include those which serve and provide benefits to communities beyond the boundaries of the CFD, including but not limited to: the construction or improvement of regional roadways and transportation systems; the expansion or improvement of water and sewer facilities that enhance the capacity of such facilities to serve communities within the region; and the construction or improvement of other public facilities (such as police stations, fire stations, and public parks and recreational facilities) that serve communities outside the proposed CFD. Generally speaking, improvements providing regional benefits will be expected to do more than simply offset or mitigate burdens on regional public facilities resulting from the development of properties within the CFD; they will be expected to produce a net improvement to such regional facilities and the public benefits produced by such facilities.

In most cases, a special improvement will not be considered as providing regional benefits if the direct benefits provided by the improvement are limited to residents and businesses within the CFD. However, certain special improvements, although primarily local in nature, may nevertheless be considered as providing regional benefits if they provide significant indirect benefits beyond the CFD boundaries. These may include, for example, innovative infrastructure facility projects within the CFD which are implemented as pilot projects and identified by the County as potentially having broader application.

b. Furtherance of Identified County Programs/Objectives.

Special improvements may provide public benefits by supporting identified County programs and objectives, such as infrastructure facilities necessary for the development of affordable housing projects (including projects to provide senior housing, low-to-moderate income housing or workforce housing) or for the revitalization of targeted areas of economic distress.

c. Environmental Benefits.

Special improvements may also be considered as providing public benefits to the extent that they help to address environmental concerns. Examples may include: acquisition and preservation of wetlands (or other significant ecological habitats) and open space; provision of public access to coastal areas and recreational trails; and construction of storm water facilities.

d. Facilities Enhanced Beyond Legal Requirements.

Under applicable land use and development laws, approvals for new property developments are typically conditioned upon compliance with various requirements regarding infrastructure facilities to be provided. While these required facilities will generally be recognized as providing public benefits, developments that meet, but do not exceed, the minimum requirements may not be regarded as providing a sufficient level of public benefits to merit funding through a CFD. Consideration will generally be given to higher levels of public benefits provided by infrastructure facilities that exceed the minimum requirements.

e. Acceleration of Improvements.

In some cases, the availability of CFD funding for infrastructure may have the effect of accelerating the completion of infrastructure facilities in comparison to other funding sources. Accelerated completion of infrastructure, in and of itself, does not necessarily provide public benefits. However, to the extent that the infrastructure itself provides public benefits, consideration may be given to the extent to which CFD funding can enhance these benefits by making them available to the public sooner.

f. Other Public Benefits.

The foregoing is not intended as an exhaustive listing of factors to be considered in determining whether improvements within a proposed CFD will provide meaningful benefits to the public. It is recognized in this regard that CFDs may provide other forms of public benefits depending on the particular facts and circumstances involved. Therefore, consideration will be given to other potential benefits in light of the applicable facts and circumstances.

3. Priority of Funding.

In order to optimize the public benefits realized through a CFD bond issue, special improvements provided by the CFD will generally be prioritized for funding purposes in the following order:

- First: Facilities that constitute regional or backbone infrastructure providing public benefits required to serve proposed development;
- Second: Other facilities addressing a clearly demonstrated public need; and
- Third: Other facilities authorized to be financed pursuant to Chapter 32.

Notwithstanding the foregoing, it is recognized that circumstances may differ significantly from one CFD to another. In appropriate cases, exceptions to the above priority may be appropriate in order to enhance the potential benefits provided to the public. The Committee will consider whether exceptions are appropriate on a case-by-case basis.

B. SPECIAL TAX FORMULAS AND MAXIMUM SPECIAL TAXES

1. Reasonable Basis of Apportionment.

Special taxes must be allocated and apportioned on a reasonable basis to all categories and classes of property (other than exempt property) within the CFD. Exemptions from the special tax may be given to parcels which are publicly-owned, are held by property owners associations, are used for a public purpose such as open space or wetlands or are affected by public utility easements making impractical their utilization for other than the purposes set forth in the easements. Other exemptions in whole or in part may also be provided to the extent deemed reasonable and equitable by the County.

2. Total Tax Burden.

The County will need to be reasonably satisfied that the total tax burden on properties within a proposed CFD will not be excessive, including the anticipated annual CFD special tax, together with *ad valorem* property taxes, special improvement assessments, special taxes for any overlapping community facilities districts, and any other taxes, fees and charges payable from and secured by the property. Limits on the CFD special taxes will be established at levels necessary to avoid undue burdens on properties, as determined by the County in consultation with the CFD appraiser, market absorption consultant and other special consultants to the County.

3. Rate and Method of Apportionment.

The rate and method of apportionment for CFD special taxes must be structured so as to produce annual special tax revenues sufficient to pay reasonable and necessary annual administrative expenses of the CFD and 110% of the annual debt service on all CFD bonds. Additionally, the rate and method of apportionment may be structured so as to produce amounts sufficient to fund (a) any amounts required to establish or replenish any reserve fund established for a CFD bond issue, (b) amounts to pay directly the costs of public facilities authorized to be financed by the CFD, (c) amounts to pay the costs of services authorized to be financed by the CFD, (d) the accumulation of funds reasonably required for future debt service on CFD bonds, (e) amounts equal to projected delinquencies in special tax payments, (f) remarketing, credit enhancement or liquidity fees, and (g) any other costs or payments permitted by law.

Generally, the rate and method of apportionment for CFD special taxes will be required to include a back-up tax so that changes in development within the CFD would not result in the inability to levy special taxes that would produce special tax revenues in such amounts.

4. Increases in Special Tax.

Generally, the maximum special tax levied to finance public facilities for any parcel within a CFD for which a building permit for the construction of a for-sale residential unit has been issued shall not escalate. However, the County may, in its discretion, on a case-by-case basis, allow such maximum special tax to escalate annually in an amount not exceeding the maximum specified in the applicable RMA. The increase in the special tax levied on any parcel within a CFD as a consequence of delinquency or default by the owner on any other parcel may not exceed the maximum specified in the applicable RMA.

5. Prepayment of Special Tax.

Typically, the RMA for a CFD will be structured so as to allow the prepayment of special taxes by a property owner. The applicable prepayment provisions must provide for payment of the property owner's allocable share of the CFD bonds and other CFD costs for which the owner is responsible.

C. APPRAISALS

Chapter 32, Section 32-18, provides in relevant part that: "No district shall be established unless the council finds that the appraised value of the land in the district (in accordance with prevailing standards of appraisal then used by financial institutions for loans thereon) is at least two times the estimated cost of the proposed improvement..." The appraised value of the land in a proposed CFD must be included in the report on the CFD to be filed by the Director of Public Works under Chapter 32, Section 32-21, within 60 or 90 days after adoption of the ROI for a proposed CFD (depending on whether or not a public hearing is held for the CFD).

When the CFD is established, an appraisal will also be required in connection with the offering of CFD bonds for the CFD. Ideally, this requirement and the appraisal requirement under Section 32-18 could be satisfied by a single appraisal report. This may not be possible, however, due to timing consideration and/or the extent to which the two appraisal requirements call for inconsistent assumptions.

Each appraisal will be prepared in compliance with applicable standards under the Uniform Standards of Professional Appraisal Practice of the Appraisal Foundation, and the Code of Professional Ethics and Standards of Professional Appraisal Practice of the Appraisal Institute. Subject to such standards, the specific assumptions for purposes of Section 32-18 and for bond marketing purposes will be determined by the Committee upon consultation with the appraiser and other special consultants retained by the County.

The appraisals will be performed by the independent appraiser retained by the County. However, in appropriate cases where an appraiser has been retained by the construction lender for the proposed infrastructure improvements, the County may accept that appraiser's report for purposes of the appraisal requirement under Section 32-18. In any other cases, if an appraisal is

provided by an appraiser not retained by the County, the County may retain its own appraiser to perform an independent review of the appraisal.

D. ABSORPTION STUDY

Generally, for all new residential development, and in such other cases as may be appropriate, the County will require a market absorption study of the proposed development within the CFD. The market absorption study will provide the market absorption consultant's estimates, based on specified economic and demographic data, of the rates at which the finished products (lots or completed buildings or units) will be sold to final users and, generally, shall include an analysis of competitive prices for the product types proposed to be developed within the CFD.

E. CONSTRUCTION FINANCING

Except in unusual cases, CFD bond proceeds will not be used to fund the initial construction of the special improvements for a CFD. Instead, the Applicant will be required to construct the special improvements for a CFD with funds other than the CFD bonds, and the CFD bond proceeds will be used to acquire the special improvements upon completion. Therefore, the Applicant will need to obtain construction financing for the special improvements sufficient to fund initial construction.

F. STRUCTURAL CONSIDERATIONS FOR CFD BOND ISSUES

1. Reserve Fund.³

In order to enhance the credit quality of CFD bond issues, the County generally will require that each fixed rate bond issue be secured by a debt service reserve fund. Generally, each debt service reserve fund will be required to be funded (with cash or an acceptable reserve surety or other credit facility) in an amount equal to the lowest of the following: (a) 10% of the initial principal amount of the bonds of such issue; (b) maximum annual debt service on the bonds of such issue; or (c) 125% of the average annual debt service on the bonds of such issue. Any reserve surety or other credit facility funding such a reserve fund will generally be required to be issued or guaranteed by an entity, the long term unsecured obligations of which are rated at least "A" by Moody's Investors Service or Standard & Poor's Ratings Service. The County may, on a case-by-case basis, also require a debt service reserve fund for variable rate issues, although the reserve requirement, if any, may differ for such issues.

2. Credit Enhancement.

Where a substantial amount of the property within a CFD is undeveloped or is owned by a single owner, the County will generally require credit enhancement to increase the credit quality of a CFD bond issue, particularly where the value-to-lien ratio of a significant portion of the property

³ Chapter 32 permits the issuance of either general obligation bonds or bonds secured solely by the special taxes on properties within a CFD. A debt service reserve fund will be considered only in cases involving bonds secured solely by special taxes.

in such CFD is less than three-to-one. The County may, in its discretion, require such credit enhancement in other situations where the County deems such an increase in credit quality to be necessary, appropriate or prudent. Such credit enhancement will usually be in the form of an irrevocable letter of credit issued or guaranteed by an entity, the long term unsecured obligations of which are rated at least "A" by Moody's Investors Service or Standard & Poor's Ratings Service. Any such credit facility will generally be required to be in an amount not less than two times the amount of annual special taxes levied on undeveloped property and will be required to remain in effect until such property is developed or the value thereof has otherwise been sufficiently increased. The actual requirements for any particular credit facility will be determined on a case-by-case basis to address deficiencies in land values and other relevant circumstances.

3. Capitalized Interest.

Where appropriate, capitalized interest (i.e., interest during construction) will be funded from CFD bond proceeds. Capitalized interest can improve the credit quality of CFD bonds and result in lower borrowing costs. However, the funding of capitalized interest also uses debt capacity that could otherwise be used to fund additional infrastructure improvements. The amount of capitalized interest to be funded will be determined on a case by case basis.

4. Bond Structure.

Under Chapter 32, the term to final maturity of CFD bonds may not exceed 40 years. The actual term to maturity of each issue will be determined on a case-by-case basis. CFD bonds will generally be structured such that, once principal amortization thereof has commenced, debt service thereon will be substantially level. However, the County may, in its discretion, on a case-by-case basis, allow such bonds to be structured such that debt service thereon escalates annually within specified limits.

G. DISCLOSURE REQUIREMENTS FOR BOND ISSUES

1. Initial Disclosure.

Each owner of property within a CFD that has not reached its planned development stage and that will be responsible for a substantial portion (as determined by the County) of annual debt service on an issue of CFD bonds will be required to provide for inclusion in the official statement or other offering materials distributed in connection with the offering and sale of such bonds such information as may be required for the County to comply with, satisfy any requirements of, or avoid any liability under, any applicable federal or state securities laws. Each such property owner will be required to verify in writing the accuracy and completeness the information so provided for inclusion in the official statement or other offering materials.

2. Continuing Disclosure.

Each owner of property within a CFD that has not reached its planned development stage and that will be responsible for a substantial portion (as determined by the County) of annual debt service on an issue of CFD bonds will be required to provide such information, on an ongoing basis, as may be required for the underwriter of such bonds to satisfy the requirements imposed on

it pursuant to Rule 15c2-12 promulgated under the Securities Exchange Act of 1934. Each such property owner will be required to provide a written commitment to provide such information for so long as the property owner remains responsible for a substantial portion of the annual debt service on the CFD bonds.

H. DISCLOSURES TO PROSPECTIVE PROPERTY PURCHASERS

In order to ensure that prospective property purchasers are fully informed about their special tax obligations imposed under Chapter 32, the County will require that proper disclosure statements regarding such special tax obligations be made to prospective property purchasers. Such disclosure statements will be subject to approval by the Committee, and will include the following information:

- a statement that the property being purchased is subject to a special CFD tax which is in addition to regular County property taxes;
- the maximum annual amount of the special tax, the number of years over which it will be levied and the permitted amount of annual increases;
- the prepayment provisions for the special tax;
- if the property owner fails to pay the special tax, the County may foreclose on the property to collect the delinquent special tax; and
- such other information regarding the CFD and special tax as may be required by the Committee.

I. CRITERIA INTENDED AS GUIDELINES; WAIVERS AND AMENDMENT

The review procedures and criteria set forth herein reflect the administrative guidelines for the consideration of proposed CFDs by the County. The County may, in its discretion, require additional or different procedures and review criteria, enhanced security and higher standards in particular cases.

The administrative guidelines set forth herein may be amended at any time and by the Committee and will be forwarded to the Council.

**COUNTY OF HAWAII
COMMUNITY FACILITIES DISTRICT FINANCING PROGRAM**

**Application for Formation of
Community Facilities District**

Instructions:

The following Application will be required for consideration of a proposed Community Facilities District (a "CFD") under Chapter 32 of the Hawaii County Code ("Chapter 32"). Reference should be made to Chapter 32 and the County's Administrative Guidelines for Evaluation of Proposed Community Facilities Districts (the "Administrative Guidelines") for further information regarding matters to be addressed in this Application.

Three completed and signed copies of this Application, including attachments, should be submitted to the Director of Finance of the County of Hawaii. The Application will be reviewed by the County's CFD Review Committee, which consists of the following officials or their respective designees: Managing Director; Finance Director; Planning Director; Director of Public Works; and Corporation Counsel.

Attach additional sheets as necessary. Attachments should identify the specific sections of this Application to which they relate.

I. BASIC INFORMATION REGARDING APPLICANT AND OTHER INTERESTED PARTIES

A. The Applicant¹

Name: _____

Mailing Address: _____

Contact Person: _____

Title: _____

Telephone: _____

Facsimile: _____

E-Mail: _____

¹ Pursuant to Chapter 32, the Applicant must own at least 25% of the land within the proposed CFD in order to petition the County Council to institute proceedings for formation of the CFD. If the Applicant does own the requisite percentage of land within the proposed CFD, this requirement can be met on a combined basis by two or more co-Applicants. In such event, the Application must be submitted jointly by the co-Applicants.

B. Contractor/Developer (if other than Applicant)

Name: _____
Mailing Address: _____

Contact Person: _____
Title: _____
Telephone: _____
Facsimile: _____
E-Mail: _____

C. Legal Counsel

Attorney/Firm: _____
Mailing Address: _____

Contact Person: _____
Title: _____
Telephone: _____
Facsimile: _____
E-Mail: _____

D. Other Consultants

Name: _____
Role: _____
Mailing Address: _____

Contact Person: _____
Title: _____
Telephone: _____
Facsimile: _____
E-Mail: _____

II. PROPOSED CFD

A. Location/Boundaries of Proposed CFD

Provide a map and narrative description identifying the location and boundaries of the proposed CFD. If separate improvement areas within the CFD are proposed, this information should indicate the boundaries of each improvement area.

B. Overall Project Development Plans

Describe the development plans for the property within the proposed CFD, including reasonable detail regarding: the proposed uses (residential, commercial etc.); types, numbers of units and acreage applicable to each use; development schedule; and other information reasonably necessary to understand the nature and scope of the development plans.

C. Proposed Special Improvements

Describe the proposed special improvements to be funded through the establishment of the proposed CFD. (See Administrative Guidelines: Part II, Section A.1 for a listing of eligible improvements.) Description should include a cost breakdown and construction timetable.

D. Public Benefits to be Provided

Describe the public benefits expected to be provided as a result of the funding of the proposed special improvements by the proposed CFD. (See Administrative Guidelines: Part II, Section A.2 for a discussion of required public benefits.)

E. Other Infrastructure Needs

Identify all required infrastructure facilities that will serve the proposed CFD, but will not be funded by the CFD. Provide cost estimates and identify funding sources.

F. Permits and Approvals

Identify all pending and issued governmental permits and approvals required for the development of the property within the proposed CFD (including the overall project components, special improvements and other required infrastructure identified in B, C and E above). In the case of pending permits and approvals, provide information regarding the status of the application and anticipated issuance date.

G. Appraisals and Other Studies

Provide copies of all appraisal(s) of the property within the proposed CFD. If an additional appraisal will be required to obtain financing for construction within the proposed CFD, identify the appraiser and the anticipated issuance date for the appraisal.

Provide copies of all other studies, including marketing studies and financial feasibility studies, prepared with respect to the proposed CFD and/or the development plan components identified in B above.

H. Other Information

1. Are there any other community facilities districts or special improvement districts that will overlap the boundaries of the proposed CFD? Yes No If yes, please identify such other district(s) by name and number assigned by the County, and identify the overlapping boundaries on the map of the proposed CFD.

2. Is 100% of the property within the proposed CFD owned by the Applicant (or co-Applicants)? Yes No If no, identify all other property owners, show their properties on the map of the proposed CFD, and provide information about their level of support for the proposed CFD.

3. Is the property within the proposed CFD current on property taxes? Yes No If no, provide further information.

III. PROPOSED FINANCING ARRANGEMENTS

A. Construction Financing for Special Improvements

As indicated in the Administrative Guidelines (see Part II, Section E therein), applicants will generally be required to obtain construction financing for the CFD special improvements subject to repayment from CFD bond proceeds upon completion of the improvements. Provide information regarding the anticipated source and amount of construction financing. If available, provide a copy of the signed loan commitment letter. If application for financing is pending, identify the financing source and provide information regarding the status of the loan application and anticipated commitment date.

B. Other Financing Commitments

Provide information regarding the anticipated sources and amounts of financing to be obtained for project components and infrastructure requirements (other than special improvements to be funded by the proposed CFD) identified in II.B and II.E above. If available, provide copies of signed financing commitments. If application for financing is pending, identify the financing source and provide information regarding the status of the application and anticipated commitment date.

C. Project Financing Pro Formas

Provide project financing pro formas, including projected timelines, reflecting the amounts and sources of financing identified in A and B above.

IV. ADDITIONAL INFORMATION

A. Identify up to three banking references, including the name and address of the banking institution, and the name and contact information for the bank representative to be contacted.

B. Provide recent financial statements of the Applicant and/or other information demonstrating past financial performance.

C. Has the Applicant been in bankruptcy? Yes No If yes, provide further information.

D. Is the Applicant current on all tax obligations? Yes No If no, provide further information.

E. List previous experience with developments of similar type and/or size, including location, size, project mix, year of completion and Applicant's involvement.

F. Were any of the listed prior developments funded by CFD bonds? Yes No If yes, (a) identify the bond-financed developments on the list, (b) confirm whether the bonds have been in default (whether or not cured), and (c) confirm whether the Applicant has been in default (whether or not cured) of any continuing disclosure obligations relating to the bonds.

Submitted by:

Applicant: _____

By: _____

Name: _____

Title: _____

Date: _____

COUNTY OF HAWAI'I

PROPOSED COMMUNITY FACILITIES DISTRICT

DEPOSIT AND REIMBURSEMENT AGREEMENT

THIS AGREEMENT is made and entered into this _____, 20__, by and between the County of Hawai'i (the "County"), and _____, a _____ (the "Proponent"), which owns the property within the boundaries of a proposed community facilities district.

RECITALS

- A. The Proponent owns the real property that is included within the proposed boundaries of a proposed community facilities district (the "Proposed District") for the development known as _____ (the "Development Project"). The Proposed District is proposed to be established pursuant to the provisions of Chapter 32 of the Hawai'i County Code, as amended ("Chapter 32") for financing the acquisition, construction and installation of "special improvements" (as defined in Chapter 32) (the "Special Improvements") which the Proponent is required to provide in connection with the Development Project.
- B. The Proponent has agreed to advance funds to allow the County to pay all costs and expenses of the County related to proceedings heretofore and hereafter conducted for the establishment of the Proposed District and the issuance of special tax bonds for the Proposed District pursuant to Chapter 32 (the "Proposed Bonds").
- C. The parties hereto wish to enter into an agreement to define the terms and conditions under which the funds will be advanced and subsequently reimbursed.

AGREEMENT

In consideration of the mutual promises herein contained, the parties hereto do hereby agree as follows:

Section 1. Proponent's Deposit; Use of Deposited Funds.

- (a) The Proponent agrees to deposit initially the sum of [\$75,000] (together with additional deposits hereunder, the "Deposit") with the County to

pay one hundred percent (100%) of the costs and expenses of the County relating to the proceedings for the formation of the Proposed District and the issuance of the Proposed Bonds (collectively, the "County Costs"), including without limitation: (i) the fees and expenses of the County's special tax consultant, financial advisor, appraiser, absorption consultant, legal counsel (including bond counsel and special tax counsel), consulting engineers and other professional consultants and advisors (individually a "Consultant" and collectively the "Consultants"); (ii) publication costs and other out-of-pocket expenses; (iii) a reasonable charge (if applicable) for County staff time; and (iv) other County staff and administrative costs.

(b) The County may draw upon the Deposit to pay the County Costs from time to time. The County shall not be obligated to advance any of its funds for purposes of forming the Proposed District or the issuance and sale of the Proposed Bonds.

(c) In the event that the balance of the Deposit falls below [\$20,000], or is otherwise insufficient to pay any County Costs due or coming due, the Proponent shall deposit additional monies with the County in the amount necessary to restore the balance of the Deposit to [\$75,000] and/or pay the County Costs due or coming due. The Proponent shall deposit such additional monies within ten (10) calendar days of the receipt of written notification from the County of the need for such additional funds. Without limiting any other right of the County to discontinue proceedings relating to the Proposed District or the Proposed Bonds, it is expressly understood and agreed that the County shall have the right to suspend or terminate all proceedings for the establishment of the Proposed District and/or the issuance of the Proposed Bonds in the event that the Proponent fails to deposit such additional monies with the County within said ten (10) calendar days.

(d) The County shall provide monthly statements to the Proponent showing the amount disbursed from the Deposit and the remaining balance thereof. The County agrees to keep such records as are reasonably necessary to show the amount of monies disbursed for payment of County Costs. The County shall make such records available to the Proponent upon request.

Section 2. Consultants, Compensation, and Method of Payment.

The County shall retain the Consultants upon such terms as it deems appropriate in its sole discretion. The County shall have the sole discretion to select the persons or firms to be retained as Consultants, and to evaluate their performance and the reasonableness of their compensation. Compensation shall be paid to each Consultant for work performed as specified in their respective contracts with the County. Upon request, the County shall provide the Proponent with a summary of fees paid to the Consultants on a bi-monthly basis.

Section 3. Reimbursement to Proponent. If the Proposed District is established and the Proposed Bonds are issued, the Proponent shall be entitled to be reimbursed for Deposit, without interest, from the proceeds of the Proposed Bonds. In the event that the net proceeds of the Proposed Bonds, after deducting the costs of issuance from the proceeds received by the County, are insufficient to fully fund both (i) reimbursement of the Deposit and (ii) financing of the Special Improvements, the Proponent shall advise the County in writing whether it wishes to receive reimbursement of the Deposit or to waive its entitlement to such reimbursement. In the event that the Proposed Bonds are issued in multiple series, waiver of reimbursement with respect to a given series shall not constitute a waiver of reimbursement from the proceeds of any subsequent series. If the proceedings are abandoned for any reason prior to the sale and issuance of the Proposed Bonds, the obligation of the County to reimburse the Proponent for the Deposit or any portion thereof shall be strictly limited to that portion of the Deposit not yet expended, and the provisions of subsection (c) of Section 5 hereof shall govern the application of such unexpended portion of the Deposit.

Section 4. Ownership of Documents. All plans, specifications, reports, appraisals and other documentation prepared as part of the proceedings to establish the Proposed District and to sell and issue the Proposed Bonds shall become the property of the County, regardless of whether the Proposed District is formed and/or the Proposed Bonds are sold and issued; provided, however, that the Proponent shall be entitled to use the information contained in such documents.

Section 5. No Obligation to form a Community Facilities District; Abandonment of Proceedings.

(a) The County expressly reserves the right to abandon the proceedings for the establishment of the Proposed District and/or issuance of the Proposed Bonds for any reason at any time prior to the completion thereof. Without limiting the generality of the foregoing, the Proponent expressly acknowledges that the decision of the County to form a community facilities district and/or to issue special tax bonds under Chapter 32 is an exercise of the legislative authority of the Council of the County, and that the County may not enter into a contract or obligate the Council to exercise its legislative discretion in a particular manner. This Agreement does not, therefore, in any way create a contractual, legal or equitable obligation of or commitment by the County to approve the formation of the Proposed District or to sell the Proposed Bonds to finance the Project.

(b) Should the Proponent elect to abandon the proceedings, the Proponent shall provide written notification of such election to the County and request the County to terminate all consulting agreements and use reasonable efforts to minimize any and all additional County Costs.

(c) If proceedings to form the Proposed District and/or issue the Proposed Bonds are not completed and are abandoned for any reason at any time, there will be no obligation on the part of the County to reimburse the Proponent for any monies previously advanced pursuant to this Agreement. In such event, the County, however, agrees to return to the Proponent such portion of the remaining balance of the Deposit, without interest, as the County determines to be in excess of the amount necessary to pay any outstanding County Costs which the County is obligated to pay, which determination shall be made as soon as reasonably practicable. If, for any reason, the remaining balance of the Deposit is not sufficient to pay all outstanding County Costs, the Proponent shall deposit such additional amounts as are required to pay all such County Costs.

(d) It is hereby expressly acknowledged and agreed that this Agreement is not a debt or liability of the County, and that the County shall not be obligated to advance any of its funds for purposes of forming the Proposed District or issuing the Proposed Bonds.

Section 6. Authority to Execute Agreement. The County and the Proponent each represents that it has the authority to execute, deliver and perform its obligations under the terms of this Agreement and that the individual(s) signing this Agreement on its behalf have full right and authority to bind said party to this Agreement.

Section 7. Designated Representatives; Notices. The following individuals are hereby designated as representatives for the County and the Proponent, respectively, to act as liaison between the parties:

County:

Director of Finance (or his/her designee)
County of Hawaii
25 Aupuni Street, Rm. 118
Hilo, Hawaii 96720

Proponent:

[Contact Person/Address]

Any written notice, statement, demand, consent, approval, authorization, offer, designation, request or other communication to be given hereunder shall be given to the party entitled thereto at its address set forth above, or at such other address as such party may provide to the other party in writing from time to time. Each such notice, statement, demand, consent, approval, authorization, offer, designation, request or other communication hereunder shall be delivered to the

party to whom it is addressed (a) if personally served or delivered, upon delivery, (b) if given by electronic communication, whether telex, telegram, electronic mail or telecopy upon sender's receipt of an appropriate answerback or other written acknowledgment, (c) if given by registered or certified mail, return receipt requested, deposited with the United States mail postage prepaid, 72 hours after such notice is deposited with the United States Mail, (d) if given by overnight courier, with courier charges prepaid, 24 hours after delivery to said overnight courier, or (e) if given by any other means, upon delivery at the address specified in this Section.

Section 8. Jurisdiction and Venue. Each of the County and the Proponent (a) agrees that any suit action or other legal proceeding arising out of or relating to this Agreement shall be brought in state court in the County of Hawaii, (b) consents to the jurisdiction of each such court in any suit, action or proceeding, and (c) waives any objection that it may have to the laying of venue or any suit action or proceeding in any of such courts and any claim that any such suit, action or proceeding has been brought in an inconvenient forum.

Section 9. Amendments. This Agreement may be amended by an instrument in writing executed and delivered by the parties hereto.

Section 10. Waivers. No waiver of, or consent with respect to, any provision of this Agreement by a party hereto shall in any event be effective unless the same shall be in writing and signed by such party, and then such waiver or consent shall be effective only in the specific instance and for the specific purpose for which it was given.

Section 11. Indemnification. The Proponent hereby indemnifies, and agrees that it shall defend and hold harmless, the County and its officials, employees, contractors and agents, from and against any and all actions, claims, damages, losses or expenses of any kind whatsoever arising out of or relating to any acts or omissions on the part of the Proponent or any of its officers, employees, contractors or agents with respect to the Proposed District or the Proposed Bonds.

Section 12. Governing Law. This Agreement has been executed in and shall be governed by the laws of the State of Hawaii.

Section 13. Construction. The parties to this Agreement and their counsel have reviewed and revised this Agreement, and the normal rule of construction to the effect that any ambiguities in an agreement are to be resolved against the drafting party shall not be employed in the interpretation of this Agreement.

Section 14. Severability. If a provision of this Agreement is found to be void, illegal or unenforceable, then any such provision shall be deemed stricken

and the remaining provisions hereof shall, nevertheless, remain in full force and effect.

Section 15. Entire Agreement. This Agreement shall constitute the entire Agreement between the parties. Any amounts to or clarification necessary to this Agreement shall be in writing and acknowledged by all parties to the Agreement.

Section 16. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall constitute an original, and all of which together shall be considered one and the same instrument.

IN WITNESS WHEREOF, the parties hereto have executed and delivered this Agreement as of the date and year first above written.

COUNTY OF HAWAI'I

By: _____
Name: _____
Title: _____

[PROPONENT]

By: _____
Name: _____
Title: _____

EXHIBIT B: CFD APPLICATION

Transmittal Email to the County

Malia:

Enclosed is a preliminary CFD Application (“Application”) to initiate the County’s review. By October, we intend to supplement this Application with a petition of a minimum of 25% of the owners or land area within the proposed district to formally institute the process pursuant to HCC section 32-18. We would like to discuss the County’s policy regarding the deposit as it applies to community-initiated CFDs.

This preliminary Application is based on key assumptions listed below that we are available to assist the County to confirm in the next few weeks. We will provide you with additional information as they become available from the work being conducted by our special tax consultant, environmental consultant, engineer, and community engagement consultant. We are available for any questions or meetings, and look forward to working with you and other members of the County. We are willing to coordinate meetings or take on whatever tasks to make this process as easy on you and your staff as possible.

The following are our key assumptions:

1. **Low Pressure System.** Our draft preliminary engineering report (PER) describes the proposed low pressure collection system. Although this would be the first low-pressure system under the County, *our Application assumes DEM will accept this system for the reasons set forth in the CFD Application section 2.3 (Proposed Special Improvements).*
2. **Private Property Components.** The PER describes the low pressure system components that are within the rights-of-way and within each private property lot. The components on private property are integral to the low pressure system. The system cannot work without this component, and is very different from a typical house connection to a lateral for a gravity system. Overall, a low pressure system costs substantially less than a gravity system, primarily because a low pressure system does not require the extent of excavation as a gravity system. Because both the components within the rights-of-way and the components on private property are part of one system, the components on private property should meet the test of a public purpose (the Application sets forth the public purposes in section 2.4). Hence, *our Application assumes in section 2.3 (Proposed Special Improvements) that the components on private property can be funded by the CFD as private improvements with a public purpose or public improvements granted to the County via an easement. Even if granted, the Application assumes that the homeowner would remain responsible for maintenance of the components within the easement.*
3. **Public Sewer Connecting to a Private WWTP.** The PER describes alternative routes to connect to Mauna Lani’s WWTP, owned by Hawaii American Waters. [Note: We will provide a will-serve letter of commitment from American Waters in the revised CFD Application. This letter will confirm the adequacy of the WWTP capacity to accommodate the projected flows from Puako and other potential future hookups, without any required expansion to the WWTP.] Because of the adequacy of the WWTP and willingness of its owner to accommodate the Puako flows, there is no need to

construct a costly new County WWTP. The proposed connection to this private WWTP neither displaces nor forecloses feasible employment opportunities for County civil service WWTP plant operators. *Since there are no other existing similar situations in this County where a public sewer line connects to a private WWTP, our Application assumes there are no legal issues related to public labor unions or government bonds for a CFD to fund a public sewer system that connects to an existing private WWTP. Furthermore, this Application assumes that legal or policy changes can be made as needed to authorize an allocation of the monthly DEM fees to pay the private WWTP's operational costs as regulated under the PUC (see discussion in section 2.5).*

4. **Appraisal.** Although the CFD Guidelines require an appraisal(s), *we assume in section 2.7 that tax assessed values suffice in this case of an existing built community.*
5. **Revolving Loan.** In the past, this County has fronted the formation costs of improvement districts to address the water and wastewater needs of other existing communities (e.g., Coastview/Wonderview, Lono Kona). Our Application is a unique case where an existing community is offering to shoulder the burden of the formation costs. The Puako community has already spent over \$2M in prior studies to get this far, and conducts annual fundraisers to keep moving ahead. However, the costs for the next steps, particularly the costs to prepare the construction documents, will be nearly a million dollars. *For situations where existing communities are willing to pay for special improvements through a CFD (unlike a developer who could privately gain), we are consulting with various County officials whether a revolving loan pursuant to 32-11 could be established to help pay for upfront costs (see discussion in section 3 on alternative financing sources we are exploring).*
6. **USDA.** We have met with USDA, and they have preliminarily confirmed that the Puako area is eligible for a USDA loan (the average income is too high for a grant portion). *In section 3, we assume that the County would be willing to be the borrower for a USDA loan, bid the project, and take ownership of the system as they have done so in the past.*

COUNTY OF HAWAII
FINANCE DEPARTMENT
COMMUNITY FACILITIES DISTRICT PROGRAM
 Application for Formation

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1 BASIC INFORMATION REGARDING APPLICANT AND OTHER INTERESTED PARTIES

Overview: *Community members of Puako formed a nonprofit organization (the “Applicant”) to replace the individual wastewater systems within the Puako community with a low-pressure County sewer line (“Special Improvements”), motivated to alleviate the damage being done to the coral reefs by the wastewater leachate. The Applicant has met with and garnered the consent of the owner of the nearby private Mauna Lani wastewater treatment plant to connect to this facility. The Applicant would substantially fund the cost of forming the proposed CFD through donations or other assistance.*

1.1 Applicant

Name: *Puako for Reefs, a community-based 501(c)(3) nonprofit corporation (see Exhibit A)*

Mailing Address: 69-1536 Puako Beach Drive, Kamuela, HI 96743
Contact Person: *John Huggins*
Title: *Treasurer*
Telephone: 303-949-7010
Email: jjhuggins@puako4reefs.org

1.2 Contractor/Developer (if other than Applicant)

N/A

1.3 Legal Counsel

Attorney/Firm: *Dentons US LLP*
Mailing Address: *1001 Bishop Street, Suite 1800, Honolulu, HI 96813*
Contact Person: *William Yuen*
Title: *Partner*
Telephone: *808-441-6214*
Facsimile:
Email: william.yuen@dentons.com

1.4 Other Consultants

Name: *Goodwin Consulting Group, Inc.*
Role: *Special Tax Consultant*
Mailing Address: *655 University Ave #200, Sacramento, CA 95825*
Contact Person: *Dave Freudenberger*
Title: *Senior Principal and Founding Partner*
Telephone: *(916) 561-0890*
Facsimile: *(916) 561-0891*
Email: Dave@goodwinconsultinggroup.net

Name: *JPE Engineering Resources*
Role: *Engineer*
Mailing Address: *PO Box 551751, Kapaau, HI 96755*
Contact Person: *Jim Pederson*
Title: *Principal*
Telephone: *(808) 854-4888*
Facsimile:
Email: jpe.jim@gmail.com

Name: *PBR HAWAII & Associates, Inc.*
Role: *Planner*
Mailing Address: *1001 Bishop Street, Ste 650, Honolulu, HI 96813-3484*
Contact Person: *Vincent Shigekuni*

Title: *Executive Vice President*
Telephone: (808) 521-5631
Facsimile: (808) 523-1402
Email: *vshigekuni@pbrhawaii.com*

Name: *TBD*
Role: *Community Engagement*
Mailing Address:
Contact Person:
Title:
Telephone:
Facsimile:
Email:

2 PROPOSED CFD

2.1 Location/Boundaries of Proposed CFD

The location of this proposed CFD is in the census designated place of Puako located in the ahupua`a of Lalamilo, South Kohala District, island and County of Hawaii (see Exhibit B). The proposed boundaries of the CFD encompass approximately 200 parcels along both sides of Puako Beach Drive (see Exhibit C, Proposed District Boundary Map & TMK List). Puako Beach Drive is a County road.

Although the proposed CFD boundary encompasses State-owned parcels, these parcels will be exempted from the CFD special tax levy. There are no other exemptions. Privately owned undeveloped parcels have been included, as well as nonprofit churches.

Other land uses in the vicinity with potential to connect in the future include the Wailea community and the Wailea Bay Section of Hapuna Beach State Recreation Area. The State Park uses a Class 1 (soil treatment) onsite sewage disposal system (OSDS). The Wailea community uses eleven Class 1 and twenty Class 4 (cesspools) OSDs.¹

2.2 Overall Project Development Plans

The proposed CFD is an existing residential community served by 193 on-site sewage disposal systems (OSDS): sixty-seven Class 1 (soil treatment), one Class 2 (septic to seepage pit), three Class 3 (aerobic to seepage pit), and 122 Class 4 (cesspools)² (see Exhibit D). Based on wastewater impact to the coastal waters, Puako is Priority 1: “Hawaii Act 132 funded a study to detect OSDS pollution in coastal waters. This study included a widespread assessment of nearshore nitrogen source tracing that was used to categorize the sample areas into three categories of wastewater influence. Category 1 indicated wastewater dominated and is the

¹ (Whittier and El-Kadi)

² Ibid.

highest priority. Category 2 indicated wastewater influenced, while Category 3 indicated little to no wastewater detected. The study used thirty-three 2-kilometer swaths of coastline for intertidal seaweed surveys. Swaths were selected using modeling estimates, seaweed species availability, safety issues, and coastline access. . . In terms of Hawaii island ranking, Puakō was ranked second and had the second highest extent of wastewater detected, while Mauna Lani was ranked seventh. Overall Puakō was identified as one of the areas that should be given high priority for OSDS upgrade.”³ The UH study to develop a methodology to prioritize cesspool areas for closure concurred with the high priority for Puako with a Priority 1 designation.⁴

The land uses within the proposed district boundaries consist of (see Exhibit E-1):

- Single family dwellings (138 parcels)
- Two-unit condominiums (20 parcels)
- Multi-family condominium (1 parcel with 38 units)
- Undeveloped privately owned residential parcels (23 parcels)
- Church (1 parcel)
- Commercial (1 parcel)
- State-owned (14 parcels)

All parcels within the CFD boundary are in the State Land Use Urban District (see Exhibit E-2), General Plan Low Density Urban with the 38-unit condominium in Medium Density Urban (see Exhibit E-3), and zoned Residential (RS-10) or Resort (V-1.25) (see Exhibit E-4). The SMA boundary extends from the coastline to Queen Kaahumanu Highway (see Exhibit E-4).

The alternate routes to connect to the Mauna Lani WWTP traverse the State Land Use Agricultural and Conservation District Subzones General, Resource, and Protective (see Exhibit E-2), General Plan Open and Urban Expansion (see Exhibit E-3), and zoning districts Agricultural (A-5a) and Open (see Exhibit E-4).

2.3 Proposed Special Improvements

The attached draft preliminary engineering report (“PER”, Exhibit F) describes the special improvements to be funded through the establishment of the proposed CFD consisting of a low-pressure sewer line with the following components:

- Low-pressure sewer line within existing rights-of-way to collect the sewage and convey to the Mauna Lani Wastewater Treatment Plant; and
- Small individual pumps on each property to partially treat or grind the sewage in the process of conveying the sewage from the house to the low-pressure sewer line.

A low pressure sewer system is more cost-effective than gravity systems, especially in coastal areas with high water tables, due to the significantly reduced excavation requirements, and avoidance of multiple pump stations and force mains. According to a wastewater master plan prepared for the County, a gravity system would cost at least double the cost for a low-pressure

³ (AECOM Technical Services, Inc., 2023, p. 2-8)

⁴ (University of Hawaii, 2022)

system.⁵ The low-pressure system would be designed in accordance with the City & County of Honolulu Low Pressure Sewer Design Guidelines.⁶

The PER identified three alternative routes to connect the low-pressure sewer line within Puako Beach Drive to the Mauna Lani WWTP. All three alternatives are within an existing County right-of-way, private right-of-way, or access easements. The County would own the improvements within the County right-of-way, private rights-of-way (through easements), and on the individual lots (through easements).

The cost estimate for all system components is approximately \$9M for the infrastructure within the rights-of-way and \$7M for the improvements on individual properties for a total cost of \$16M.

[Note: A final PER is in process that would describe the individual property components in more detail and select a preferred route to connect to the WWTP, as well refine the cost estimates. Further discussion with the County is needed to address whether and how the private property components can be within an easement granted to the County but maintained by the homeowner. Alternatively, the components on the individual properties could remain privately owned, and the question would be whether it would qualify for CFD funding due to its public purpose, or require private financing. To mitigate the maintenance burden on the homeowners, PFR is researching the possibility of a collective maintenance agreement with a qualified contractor subsidized by donations.]

2.4 Public Benefits to be Provided

The substantial public benefits resulting from this project include:

- Backbone Infrastructure Providing Regional Benefits. The project will install a County low-pressure sewer line within existing rights-of-way with sufficient capacity to handle the sewage flow from the entire Puako community, as well as potential future connections from the Wailea Bay community and Wailea State Park (see Exhibit G).
- Furtherance of County Objective to Comply with State Mandated Deadline to Close Cesspools, Especially Priority 1. The County of Hawaii supported the transition from cesspools to upgrades or conversions to sewer systems by its preparation of the Island-Wide Integrated Wastewater Management Plan.⁷
- Environmental Benefits from Improved Nearshore Coastal Water Quality. The State Department of Land & Natural Resources (DLNR) has designated the nearshore coastal waters of Puako as the Puako Bay and Puako Reef Fisheries Management Area (see Exhibit G). Nearby, DLNR has designated Wailea Bay as a Marine Life Conservation District. A UH Hilo water quality study demonstrated that wastewater from OSDS was present in shoreline waters in Puako. This study contains results from the first dye tracer tests showing a direct connection between what goes down the drain of homes and what comes out at shoreline springs. Also, fecal indicator bacteria and nutrient concentrations were high, and stable isotopes of nitrogen measured in seaweed at many locations

⁵ (AECOM Technical Services, Inc., 2024)

⁶ Ibid., section 5.1.2

⁷ (County of Hawaii, 2024)

along the Puako shoreline were indicative of wastewater. Of the 16 shoreline stations sampled, three had high wastewater pollution scores, and 13 had medium scores. No stations had low wastewater pollution scores (see Exhibit H). The general public has ready access to these nearshore coastal waters via the State's Puako boat ramp and nine County public accessways maintained by the Puako Community Association (see Exhibit G).

- County-Wide Economic Benefits to Tourism. The four resorts (two south--Auberge at Mauna Lani, Fairmont Orchid, two north--Westin at Hapuna, Mauna Kea) have resort-owned activities which use the reef off of Puako. The sailing canoe at Mauna Kea, is seen often. Other smaller businesses which regularly visit the reef are: kayak tours (leaving from Puako Beach), Dive/snorkel/whale watching boats (leaving from Puako boat harbor), and other dive/snorkel boats leaving from either Kawaihae harbor or `Anaeho`omalu Bay [Note: Research is ongoing for a recreation census to document the popularity of the Puako reef area; also, an economic study may be done to document the multiplier effects generated by visitor and general public usage.]
- Innovative Pilot Project having Broader Application. This project will serve as a pilot for the following innovative ideas that may have broader applicability for other communities in other parts of the island to meet the State-mandated cesspool closure deadline:
 - Public Sewer Line Connecting to a Private WWTP. Because of the dispersed rural population on this big island, this County has the lowest number of households connected to a public wastewater treatment plant.⁸ The only alternative to build more County centralized sewer systems include upgraded individual wastewater systems or the model provided by this project.
 - Monthly Sewer Fee Allocation to Cover Private Treatment Costs. Can the same operational monthly fee collected by DEM be allocated between the PUC-approved rate charged by a private WWTP operator and the County's cost? This project will provide an answer.
 - Low-Pressure System Acceptable as County Standard. Although DEM follows C&C of Honolulu's Wastewater Standards and those standards include design guidelines for low-pressure sewers, this project would provide actual experience to tailor those guidelines as needed.
 - CFD Procedures for a Community-Initiated Project. The County's current CFD Guidelines are intended for developers who are interested to establish a CFD. For such profit-driven ventures, it makes sense for the County to have its formation costs paid by the developer. However, for community-initiated CFD's such a deposit is overwhelming. Should the procedures be different for developer vs community-initiated CFDs? This project will hopefully evolve a modified process.
 - CFD Policies for Future Connections. In the case where a CFD funds a regional backbone infrastructure with potential for future connections, how can the rate and method of apportionment be fairly established so that the early payers do not disproportionately carry the capital cost burden of future connectors who may

⁸Ibid.

wait to connect until later in the CFD amortization period? This project would examine alternative ideas.

2.5 Other Infrastructure Needs

The proposed sewerline would connect to Mauna Lani's private wastewater treatment plant owned and operated by Hawaii American Waters. The Applicant has obtained the owner's preliminary approval to connect (see Exhibit I). Because there is excess capacity, no expansion is needed to accommodate the projected wastewater flows from the project.

The PUC regulates the customer rates charged by private wastewater treatment plant operators. American Waters estimates the monthly operating rate to be approximately \$30/month, subject to PUC approval. [Need County input to address whether and how to apportion DEM's fee between DEM's operational cost and the PUC-approved rate.]

2.6 Permits and Approvals

The permits and approvals required include:

- Environmental assessment due to use of County land (right-of-way) and funds (CFD), and possibly use of federal funds;
- Special Management Area (SMA) exemption;
- Conservation District Use permit;
- Approval to use County right-of-way;
- Public Utilities Commission to expand the service area of a regulated facility.

[The final CFD application will incorporate the findings of an environmental planning consultant, PBR Hawaii, to determine the scope of environmental review.]

2.7 Appraisals and Other Studies

Because the proposed CFD district consists of a built community, tax assessed values will be used in lieu of an appraisal. The 2024 tax assessed values for the CFD district is approximately \$499,206,900, which is 21 times the total estimated cost of \$23M to be financed by the CFD.

[Note: The Final Application will be updated based on the County's confirmation to use tax assessed values in lieu of appraised values, with the latest available tax assessed values provided by the County.]

2.8 Other Information

1. Are there any other community facilities districts or special improvement districts that will overlap the boundaries of the proposed CFD? *No.*
2. Is 100% of the property within the proposed CFD owned by the Applicant? *No. The Applicant will retain a consultant to broadly outreach to the owners within the proposed*

CFD boundary. [The final CFD Application will include a petition of support from at least 25% of the owners or land area within the proposed CFD district.]

3. Is the property within the proposed CFD current on property taxes? *The Applicant can provide a proposed list of TMKs to be included within the CFD, that the County can then check whether the property taxes are current.*

3 PROPOSED FINANCING ARRANGEMENTS

3.1 Construction Financing for Special Improvements

The Applicant is exploring the following options to finance construction on an interim basis:

- County revolving fund [funded by G.O. Bond and/or State's Clean Water Revolving Fund];
- USDA loan;
- Philanthropic lender;
- Private lender.

The interim construction financing would be taken out by the closing of a USDA loan, as applicable, or the CFD bond.

[Note: Applicant is researching the above alternatives and will have a more definitive approach in the final CFD Application.]

3.2 Other Financing Commitments

The Applicant is inquiring with the USDA as to the eligibility and terms of funding for the special improvements, with any USDA loan to be repaid through the CFD. USDA would require the County to be the borrower and the owner of the funded improvements.

The Applicant is advancing the cost to form the CFD and will seek reimbursement through the CFD. The reimbursed funds may be used for a subsidy fund, administered by the Applicant, to assist qualified lower-income owners with special tax and/or maintenance costs..

3.3 Project Financing Pro Formas

The special tax consultant provided a very rough estimate proforma as follows:

**Proposed Puako Community Facilities District
CFD Bond Analysis Summary**

<u>Project Assumptions</u>		
Construction Costs		\$9,100,000
Connection Costs	\$33,000 per house	\$6,930,000
Total Construction Costs (TECC)		\$16,030,000
Design and Survey	10% of TCC	\$1,603,000
Feasibility/EA		\$250,000
Legal Fees		\$50,000
Contingency	20% of TCC	\$3,206,000
Total Estimated Development Costs		\$21,139,000
<u>Bond Assumptions</u>		
Average Interest Rate		5.00%
Month of Issuance		SEP
Months of Principal/Interest Payments		MAR / SEP
Capitalized Interest (Months)		0
Bond Term (Years)		30.0
Reserve Fund as a % of Bond Issue		6.47%
Capitalized Interest as a % of Bond Issue		0.00%
Issuance Cost / Underwriter's Discount as a % of Bond Issue		4.00%
Annual % Increase in Special Tax		0.00%
<u>Bond Uses</u>		
Construction Costs Funded by Bonds		\$21,139,000
Reserve Fund		\$1,527,809
Capitalized Interest		\$0
Issuance Costs / Underwriter's Discount		\$944,450
Total		\$23,611,259
<u>CFD Special Taxes</u>		
Total Maximum Special Taxes Required		\$1,680,590
Total Households		210
Annual Special Tax (per Household)		\$8,003

Source: Goodwin Consulting Group, Inc.

4/21/2025

[Note: A more refined number will be presented in the final CFD Application that will:

- Update the construction cost estimate based on a more detailed analysis of the individual property improvements and the selection of a preferred route to connect to the Mauna Lani WWTP;
- Reflect possible contributions from government or philanthropic sources;
- Apportion the special tax for each unit based on proposed tax rate classes.]

4 ADDITIONAL INFORMATION

N/A. The questions in this section seem to apply to a developer.

Submitted by:

Applicant: *Puako for Reefs*

By: *John Huggins, Treasurer*

Date: Draft May 23, 2025

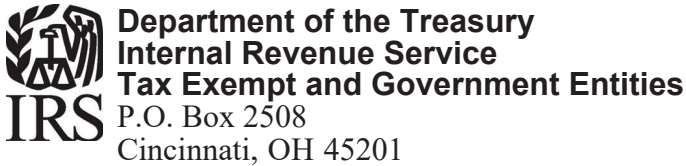
References

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Exhibits

- A. IRS 501(c)(3) Letter
- B. Location Map
- C. Proposed CFD Boundary Map & TMK List
- D. OSDS Map
- E. Land Use Maps: Existing Land Uses, State Land Use Districts, County General Plan LUPAG, County Zoning, SMA
- F. Preliminary Engineering Report (Draft)
- G. Public Benefits Map
- H. Water Quality Report
- I. Will-Serve Letter from American Waters [forthcoming]
- J. Proposed Special Tax Roll and Total Tax Assessed Value [forthcoming]

EXHIBIT A



PUAKO FOR REEFS
C/O BARBARA BELL
69-1536 PUAKO BEACH DRIVE
KAMUELA, HI 96743

Date:
09/06/2023
Employer ID number:
93-2809206
Person to contact:
Name: Customer Service
ID number: 31954
Telephone: (877) 829-5500
Accounting period ending:
December 31
Public charity status:
170(b)(1)(A)(vi)
Form 990 / 990-EZ / 990-N required:
Yes
Effective date of exemption:
August 09, 2023
Contribution deductibility:
Yes
Addendum applies:
No
DLN:
26053636004203

Dear Applicant:

We're pleased to tell you we determined you're exempt from federal income tax under Internal Revenue Code (IRC) Section 501(c)(3). Donors can deduct contributions they make to you under IRC Section 170. You're also qualified to receive tax deductible bequests, devises, transfers or gifts under Section 2055, 2106, or 2522. This letter could help resolve questions on your exempt status. Please keep it for your records.

Organizations exempt under IRC Section 501(c)(3) are further classified as either public charities or private foundations. We determined you're a public charity under the IRC Section listed at the top of this letter.

If we indicated at the top of this letter that you're required to file Form 990/990-EZ/990-N, our records show you're required to file an annual information return (Form 990 or Form 990-EZ) or electronic notice (Form 990-N, the e-Postcard). If you don't file a required return or notice for three consecutive years, your exempt status will be automatically revoked.

If we indicated at the top of this letter that an addendum applies, the enclosed addendum is an integral part of this letter.

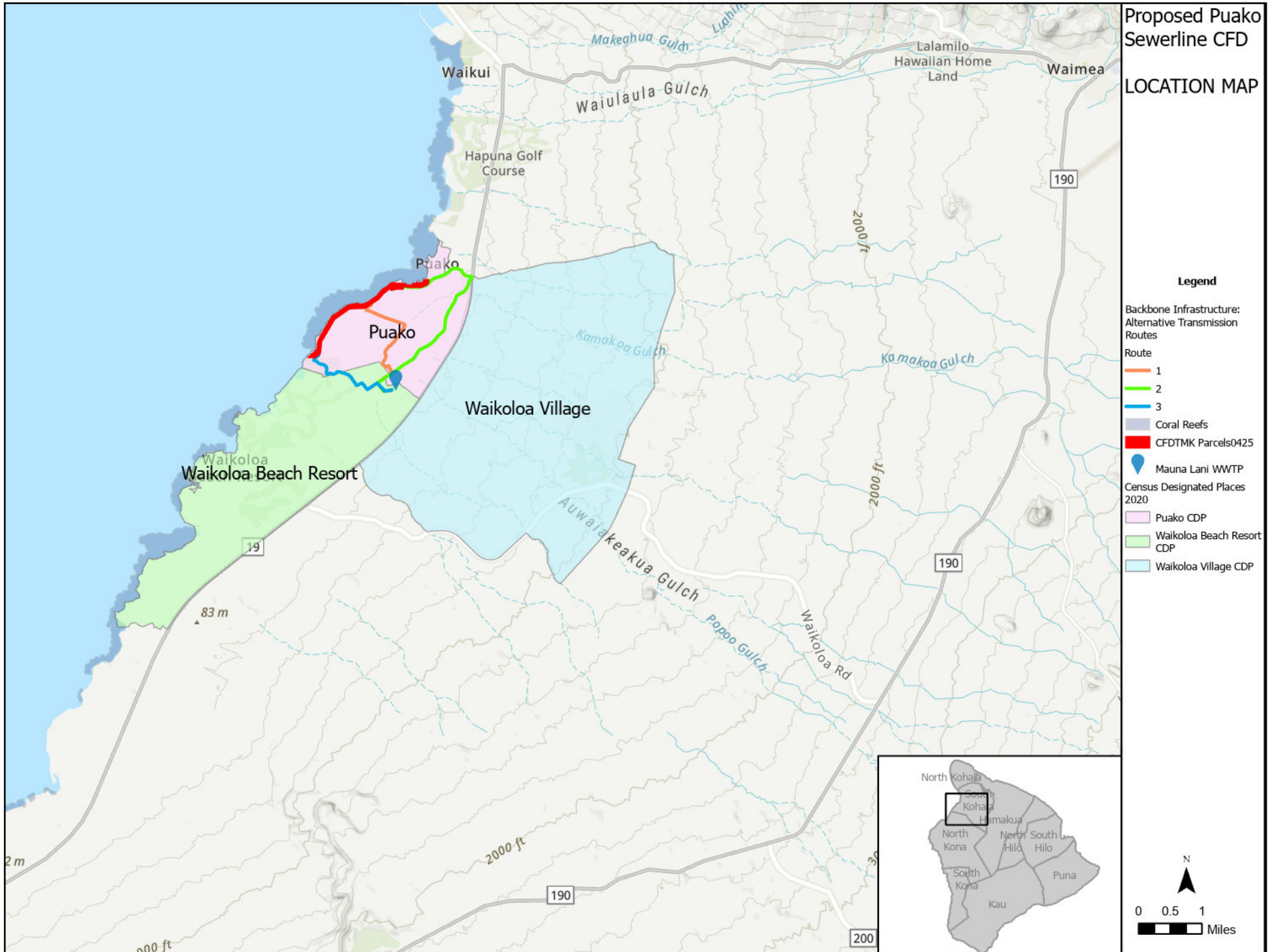
For important information about your responsibilities as a tax-exempt organization, go to www.irs.gov/charities. Enter "4221-PC" in the search bar to view Publication 4221-PC, Compliance Guide for 501(c)(3) Public Charities, which describes your recordkeeping, reporting, and disclosure requirements.

Sincerely,

A handwritten signature in cursive script that reads "Stephen A. Martin".

Stephen A. Martin
Director, Exempt Organizations
Rulings and Agreements

EXHIBIT B



TMK	Use	Units
369001007	Undeveloped	1
369001018	Undeveloped	1
369001020	Undeveloped	1
369001021	SFD	1
369001023	Undeveloped	1
369001024	Undeveloped	1
369001025	Undeveloped	1
369001026	Undeveloped	1
369001027	Undeveloped	1
369002001	SFD	1
369002002	SFD	1
369002003	Undeveloped	1
369002004	Undeveloped	1
369002005	SFD	1
369002011	SFD	1
369002012	2-unit condo	2
369002013	2-unit condo	2
369002023	Undeveloped	1
369002024	Undeveloped	1
369002025	Undeveloped	1
369002026	SFD	1
369002027	Undeveloped	1
369002030	SFD	1
369002031	SFD	1
369002033	Undeveloped	1
369002034	SFD	1
369002035	Undeveloped	1
369002036	Undeveloped	1
369003001	SFD	1
369003002	SFD	1
369003003	SFD	1
369003004	SFD	1
369003005	SFD	1
369003006	SFD	1
369003007	SFD	1
369003008	SFD	1
369003009	SFD	1
369003010	SFD	1
369003012	SFD	1
369003013	SFD	1
369003014	SFD	1
369003015	SFD	1

TMK	Use	Units
369003016	2-unit condo	2
369003018	2-unit condo	2
369003019	MFD	38
369003022	Commercial	1
369003023	2-unit condo	2
369003024	SFD	1
369003025	SFD	1
369003026	SFD	1
369003027	SFD	1
369003028	SFD	1
369003029	2-unit condo	2
369003030	SFD	1
369003031	SFD	1
369003032	SFD	1
369003033	SFD	1
369003034	SFD	1
369003035	SFD	1
369003036	SFD	1
369004002	SFD	1
369004003	Undeveloped	1
369004004	SFD	1
369004005	SFD	1
369004006	SFD	1
369004007	SFD	1
369004009	SFD	1
369004010	SFD	1
369004011	SFD	1
369004012	SFD	1
369004013	SFD	1
369004014	SFD	1
369004015	SFD	1
369004016	SFD	1
369004017	SFD	1
369004018	SFD	1
369004019	SFD	1
369004020	SFD	1
369004021	2-unit condo	2
369004022	Undeveloped	1
369004023	SFD	1
369004024	2-unit condo	2
369004025	2-unit condo	2
369004026	Undeveloped	1

TMK	Use	Units
369004027	SFD	1
369004028	SFD	1
369004029	SFD	1
369004030	SFD	1
369004031	SFD	1
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369004036	SFD	1
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369005004	SFD	1
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369005006	SFD	1
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369005009	SFD	1
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369005014	Undeveloped	1
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369005018	SFD	1
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369005021	Church	1
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369005023	SFD	1
369005024	2-unit condo	2
369005025	SFD	1
369005026	SFD	1
369005027	Undeveloped	1
369005028	SFD	1
369005029	SFD	1
369005030	SFD	1
369005031	SFD	1

TMK	Use	Units
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369005034	SFD	1
369005035	SFD	1
369005036	SFD	1
369005037	SFD	1
369005038	SFD	1
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369006024	SFD	1
369006025	SFD	1
369006026	SFD	1
369006027	SFD	1
369006028	SFD	1
369006029	SFD	1
369006030	2-unit condo	2
369006031	2-unit condo	2
369006032	SFD	1

TMK	Use	Units
369006033	SFD	1
369006034	SFD	1
369006035	SFD	1
369006036	2-unit condo	2
369006037	2-unit condo	2
369006038	SFD	1
369006039	2-unit condo	2
369006040	SFD	1
369006041	2-unit condo	2
369006042	SFD	1
369006043	SFD	1
369006044	SFD	1
369006045	SFD	1
369006046	2-unit condo	2
369006047	2-unit condo	2
369006048	SFD	1
		241
Exempt		
369001028	Roads	0
369002014	Roads	0
369002999	Roads	0
369003999	Roads	0
369004999	Roads	0
369005999	Roads	0
369006999	Roads	0
369002006	State	1
369002009	State	1
369002010	State	1
369004001	State	1
369005019	State	1
369005046	State	1
369006001	State	1
369006002	State	1
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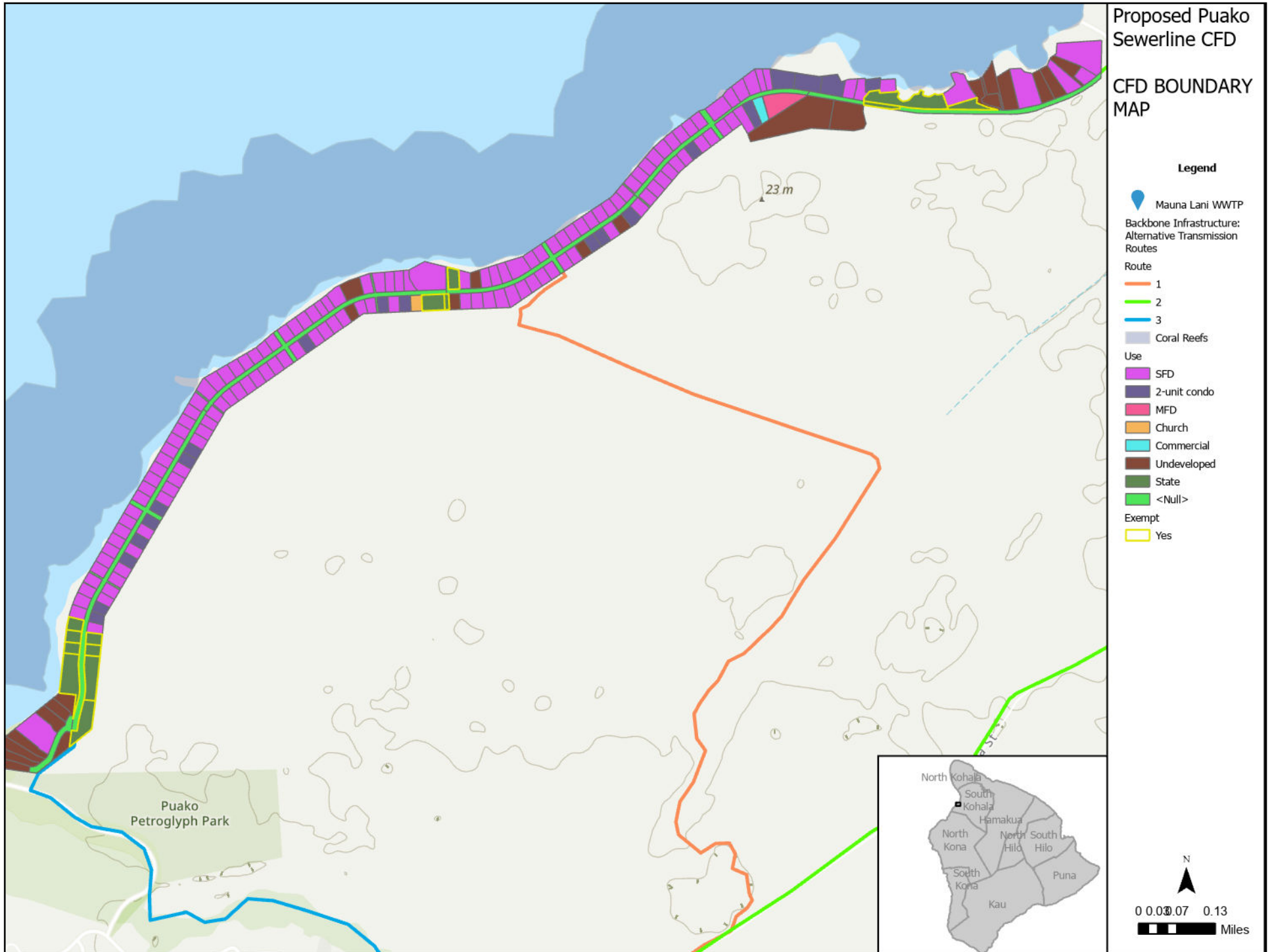


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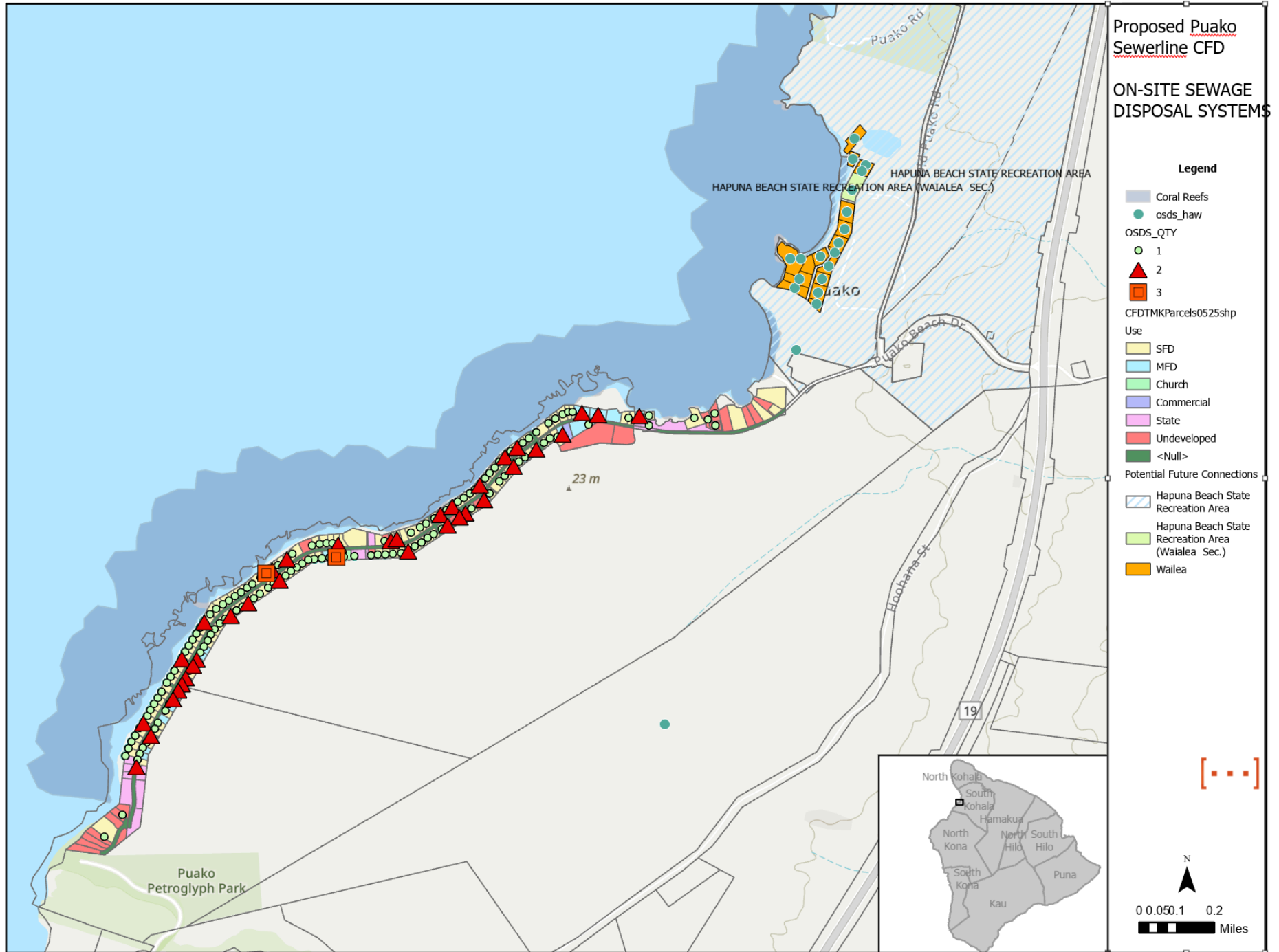


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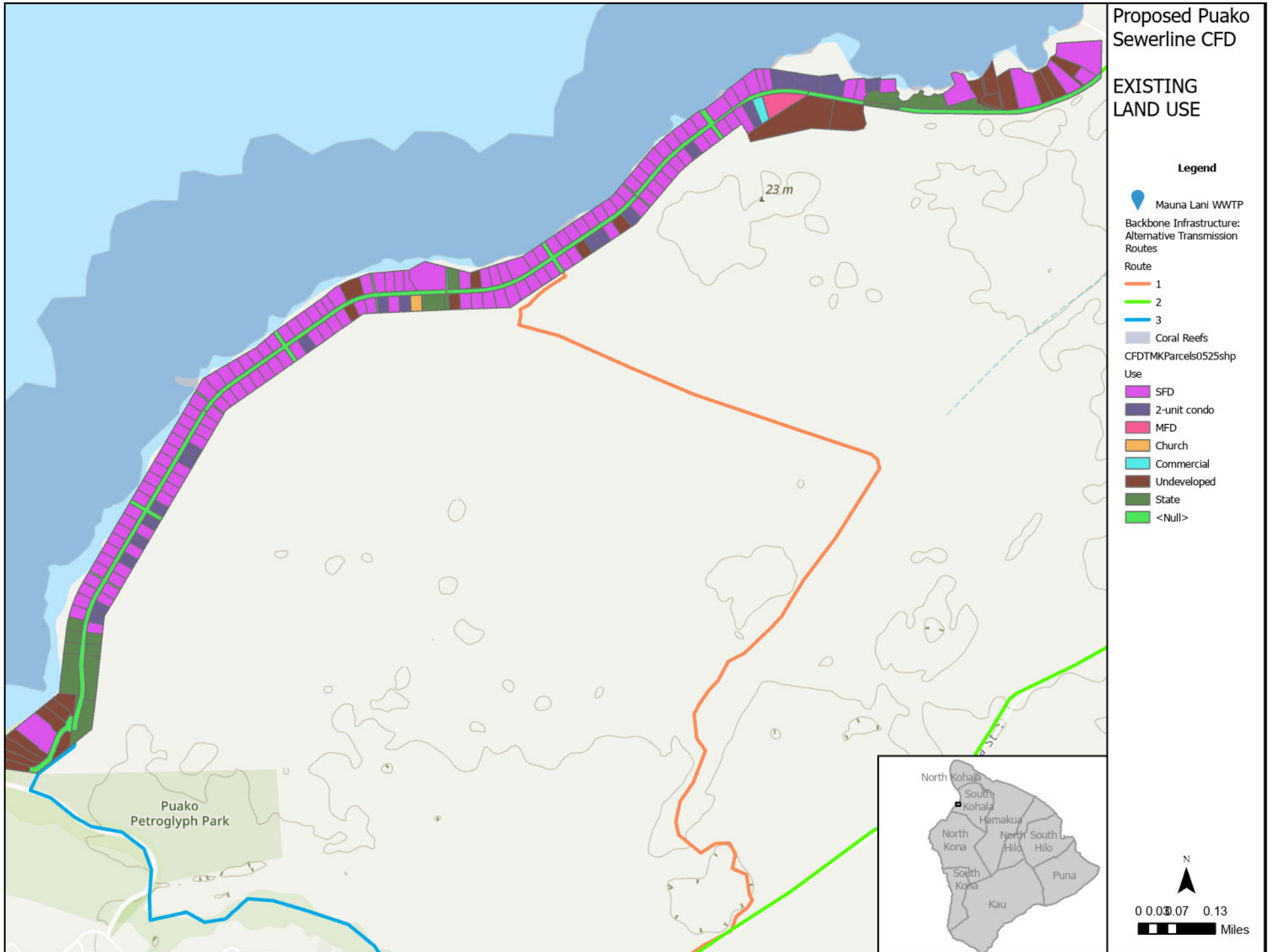


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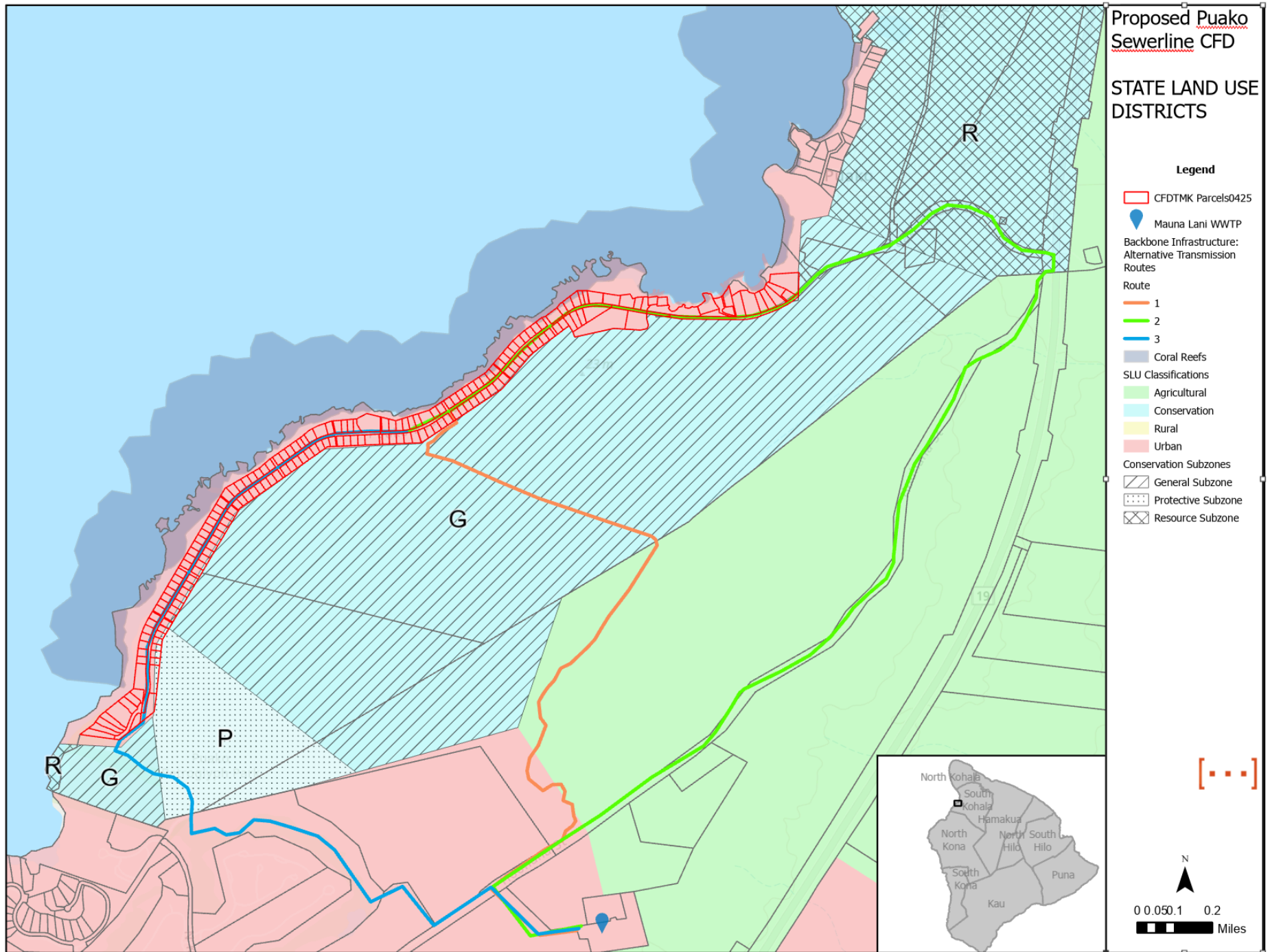


EXHIBIT B



EXHIBIT E-4

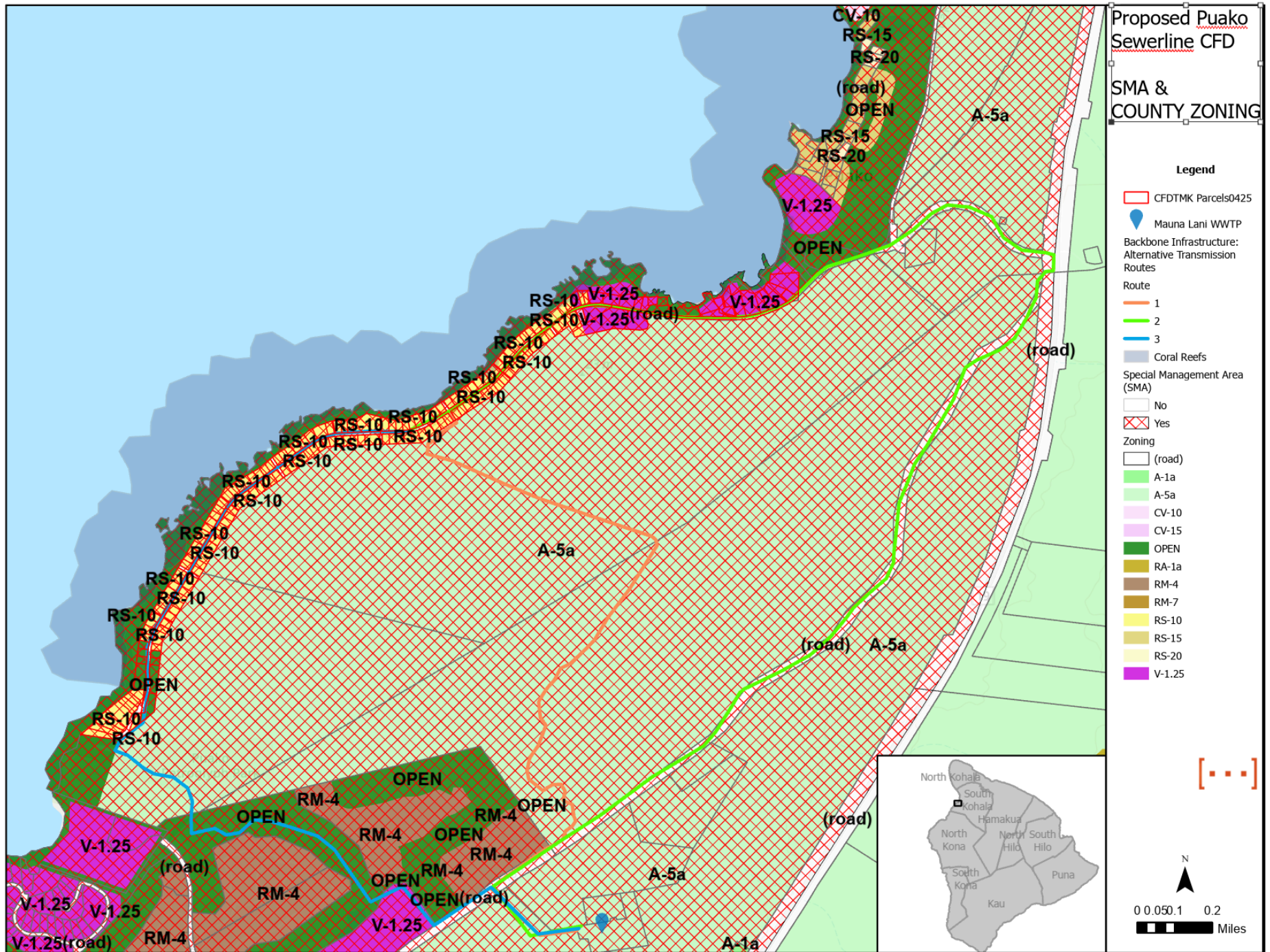


EXHIBIT B

EXHIBIT G

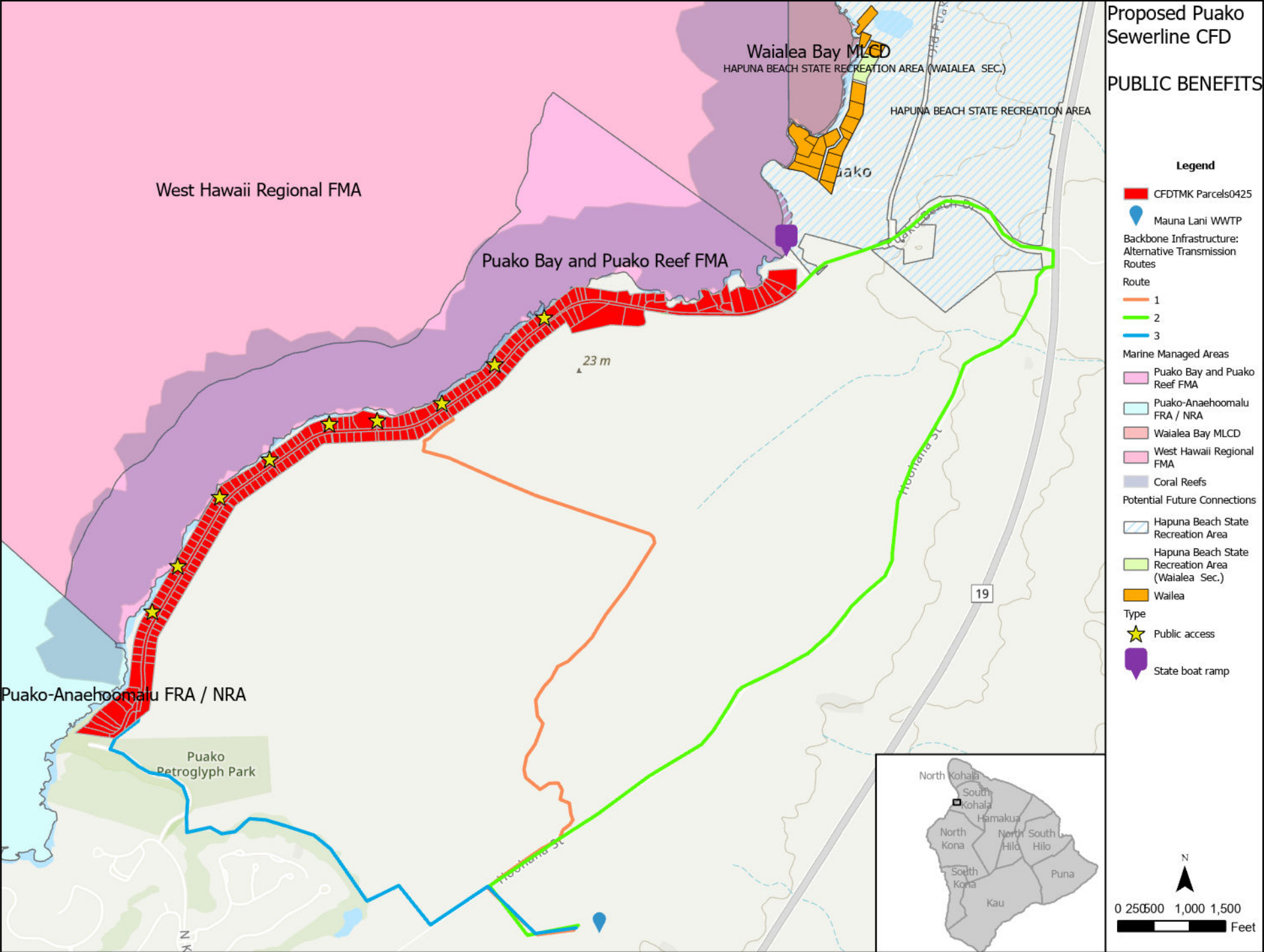


EXHIBIT B



ELSEVIER

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A multi-indicator approach for identifying shoreline sewage pollution hotspots adjacent to coral reefs



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ABSTRACT

Sewage pollution is contributing to the global decline of coral reefs. Identifying locations where it is entering waters near reefs is therefore a management priority. Our study documented shoreline sewage pollution hotspots in a coastal community with a fringing coral reef (Puakō, Hawai'i) using dye tracer studies, sewage indicator measurements, and a pollution scoring tool. Sewage reached shoreline waters within 9 h to 3 d. Fecal indicator bacteria concentrations were high and variable, and $\delta^{15}\text{N}$ macroalgal values were indicative of sewage at many stations. Shoreline nutrient concentrations were two times higher than those in upland groundwater. Pollution hotspots were identified with a scoring tool using three sewage indicators. It confirmed known locations of sewage pollution from dye tracer studies. Our study highlights the need for a multi-indicator approach and scoring tool to identify sewage pollution hotspots. This approach will be useful for other coastal communities grappling with sewage pollution.

1. Introduction

With > 50% of the world's population living within coastal areas, sewage pollution has become a growing global problem that is largely unrecognized. Untreated sewage from cesspools and septic tanks is a concern for human and environmental health in rural areas (Lapointe et al., 1990; Paul et al., 2000; Whittier and El-Kadi, 2014). Sewage pollution is a complex environmental problem because it is a cocktail containing elevated and potentially hazardous levels of pathogens, hydrocarbons, nutrients, toxins, organic and inorganic compounds, and endocrine disruptors (Wear and Vega Thurber, 2015). For example, human exposure to sewage can result in skin and urinary tract infections, hepatitis, and gastroenteritis (Pinto, 1999). Annually, there are over 120 million gastroenteritis cases worldwide associated with sewage contaminated waters (Shuval, 2003). In addition, sewage pollution can have detrimental effects on coastal ecosystems (Wear and Vega Thurber, 2015). Coral reefs, which are one of the most economically valuable and biologically diverse ecosystems in the world, are steadily declining from multiple stressors including sewage pollution

(Wear and Vega Thurber, 2015). Sewage pollution has been linked with increased coral disease prevalence and severity (Sutherland et al., 2010; Redding et al., 2013; Yoshioka et al., 2016). White pox disease in Caribbean corals is one well documented example where a human pathogen is found in sewage, *Serratia marcescens*, was shown to cause the disease (Sutherland et al., 2010), although this relationship is disputed (Lesser and Jarett, 2014). Nutrient enrichments associated with sewage can stimulate benthic algal growth, resulting in a benthic phase shift from coral-to macroalgal-dominated reefs (Hunter and Evans, 1995; Lapointe et al., 2005). These nutrients also alter coral growth rates, species distribution and abundance, and coral community diversity (Pastorok and Bilyard, 1985; Parsons et al., 2008).

As the human population and associated coastal development continues to grow, monitoring water quality for sewage pollution is essential. Dye tracer studies provide irrefutable evidence that sewage from on-site sewage disposal systems (OSDS; i.e., cesspool, septic tanks) and treatment plants is entering and contaminating water bodies (Yates, 1985; HDOH, 1984; Glenn et al., 2013). These studies reveal hydrogeologic features connecting these treatment systems to

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nearshore waters, and are used to calculate pollution transit times, flow rates, and dilution within aquifers. However, dye tracer studies are laborious with hourly, daily, and in some instances, monthly sample collections. They also occur at one location at a time, and thus, provide limited geographical information on where sewage is entering into the ocean. Hence, they are only generally conducted when it is suspected that sewage is entering the ocean from a specific site.

In contrast, measurements of fecal indicator bacteria (FIB) are a more widely used to detect sewage than dye tracer studies, and they serve as a proxy for assessing human health risks (Cabelli, 1983; Prüss, 1998). *Enterococcus* spp. is monitored in marine recreational waters by the United States Environmental Protection Agency (USEPA) and state health agencies. In tropical locations like Hawai'i, a secondary indicator, *Clostridium perfringens*, is also assessed (Fujioka et al., 1997; Fujioka et al., 2015). Unlike *Enterococcus* spp., *C. perfringens* is an anaerobic, spore-forming bacterium that does not multiply in coastal waters, nor grows in tropical soils (Hardina and Fujioka, 1991; Fung et al., 2007). Hence, it is thought to more accurately detect sewage pollution than *Enterococcus* spp. (Fujioka and Shizumura, 1985; Hardina and Fujioka, 1991; Fujioka et al., 1997).

Measurements of stable nitrogen (N) isotopic composition ($\delta^{15}\text{N}$) in macroalgal tissues is another method employed to detect sewage pollution in coastal waters (Umezawa et al., 2002; Savage, 2005; Lin et al., 2007; Dailer et al., 2012; Wiegner et al., 2016). Macroalgae minimally discriminate between ^{14}N and ^{15}N . Therefore, they have similar isotopic compositions relative to their N sources (Savage, 2005). Sewage, in particular, has a very distinct stable N isotopic composition compared to other N sources, i.e., fertilizers, soils, groundwater, and ocean water (reviewed in Wiegner et al., 2016), and thus, has been successfully used to identify locations of shoreline sewage pollution (Umezawa et al., 2002; Savage, 2005; Lin et al., 2007; Dailer et al., 2010; Dailer et al., 2012).

Nutrient concentrations are also commonly used to assess water quality. It has been shown that nutrient concentrations are significantly higher nearshore with known sewage pollution (Lapointe et al., 1990; Nelson et al., 2015). However, measuring nutrients at the shoreline alone as a sewage indicator is not informative enough for management actions because of their numerous non-sewage watershed sources. Mixing plots of nutrient concentrations and salinity, a tool commonly used for examining mixing behavior and determining nutrient sources (freshwater vs. ocean) (Officer, 1979), may be useful for identifying locations where sewage is entering coastal waters and increasing nutrient concentrations.

Due to spatial and temporal variability associated with different sewage indicators, assessing pollution from a single one can be misleading. For example, authorities are more likely to post beach advisories when using *Enterococcus* spp. rather than *C. perfringens* (Shibata et al., 2004). In addition to FIB, $\delta^{15}\text{N}$ in macroalgal tissues can be highly variable due to N inputs from different sources with differing N isotopic compositions (Ochoa-Izaguirre and Soto-Jiménez, 2015). Hence, it is imperative to measure multiple sewage indicators to determine spatial and temporal pollution patterns particularly when concerned with both human and ecosystem health. However, few studies have done this to date, with most only measuring two indicators simultaneously because methods are difficult, expensive, and time consuming (Knee et al., 2008a; Baker et al., 2010; Moynihan et al., 2012; Yoshioka et al., 2016).

Hawai'i is an ideal location to develop a multiple sewage indicator approach as its coastal waters and coral reefs have been impacted by sewage pollution for decades (Pastorok and Bilyard, 1985; Whittier and El-Kadi, 2014). Presently, cesspools are the primary source of sewage pollution in rural areas, which comprise most of the state and are the location where the healthiest coral reefs are found. Hawai'i uses cesspools more widely than any other state (USEPA, 2013), and has only recently banned the installation of new ones (HDOH Administrative Rules-Title 11, HAR, 2016). Cesspools are particularly concerning in

Hawai'i where many of the homes are in close proximity to the water on highly porous substrate. As of 2014, there were over 110,000 OSDS in Hawai'i State. On Hawai'i Island alone, there are nearly 59,000 OSDS, with 49,000 being classified as cesspools (Whittier and El-Kadi, 2014). A high-risk area where OSDS are likely impacting nearshore waters on Hawai'i Island is Puakō (Whittier and El-Kadi, 2014). Puakō is a coastal community that is home to some of the richest, most diverse reefs in the state (Hayes et al., 1982). However, coral coverage has decreased from 80% in 1975 to 33% in 2010 (Minton et al., 2012), with concurrent decreases in fish abundance (49%–69%), and increases in turf and macroalgal cover (38%) (HDAR, 2013). Declining coral health and elevated disease prevalence and severity have also been documented (Couch et al., 2014; Yoshioka et al., 2016). While sewage pollution is thought to be one of the culprits contributing to these ecosystem changes, the link between these conditions and the presence of sewage has not been made.

The goal of this study was to develop a multiple sewage indicator approach to more accurately detect the presence of sewage in Puakō's nearshore waters. More specifically, we aimed to: 1) determine whether OSDS were hydrologically connected with coastal waters, 2) measure three sewage indicators including: FIB, $\delta^{15}\text{N}$ in macroalgal tissue, and nutrients along the shoreline, 3) identify locations of shoreline sewage pollution using mixing plots, and 4) pinpoint sewage pollution hotspots by developing a sewage pollution score.

2. Materials and methods

2.1. Site description

This study was conducted along the Puakō coastline in the South Kohala region of Hawai'i Island (Fig. 1), which is primarily comprised of basalt from the Mauna Loa Volcano. Annual rainfall ranges from 250 to 750 mm and infiltration of rainwater into the aquifer is high due to the permeable substratum. Average submarine groundwater discharge (SGD) at the shoreline ranges from 2083 to 2730 $\text{L m}^{-1} \text{h}^{-1}$ (Paytan et al., 2006).

Puakō is a residential community along a 3.5 km stretch of coastline with 207 lots, of which 163 have homes. The population is growing at a rate of 6.9% per year (Minton et al., 2012). At Puakō, 47 homes have cesspools and 139 have conventional septic tanks with leach fields (Schott, 2010). The entire coastline is accessible to the public and is frequently used for recreational activities such as fishing, surfing, SCUBA diving, and snorkeling. Presently, there is one development up-slope of Puakō, Waikoloa Village, which has 2000 homes, with 1587 having OSDS; the remainder are connected to the sewer line (per. comm. Hawai'i Water Supply).

2.2. Dye tracer studies

Dye tracer studies were conducted to determine the hydraulic connectivity between OSDS at four oceanfront homes. Studies were conducted along the southern portion of Puakō's coastline where nearshore waters are relatively fresh. Three homes had cesspools, and one had a fractured aerobic treatment unit (ATU) tank (a type of OSDS that utilizes an aeration process). Two of the four homes were occupied during the studies. At each home, the closest point where dye could be delivered to the OSDS was identified. Fluorescein, a non-toxic organic dye was used for the studies. It has a strong fluorescence and detection levels as low as 1 ppb (Gaspar, 1987; Reich et al., 2001). For our studies, 500–1000 g of high purity fluorescein dye (Amresco Fluorescein Sodium Salt) was injected over ~10 h. Each hour, 50 or 100 g of dye were mixed with 20 L of tap water and slowly added to the OSDS. Additional tap water was added throughout the day and its volume recorded to calculate an initial dye concentration.

To sample for the presence of dye at the shoreline, five to six stations were identified in front of each home and adjacent properties

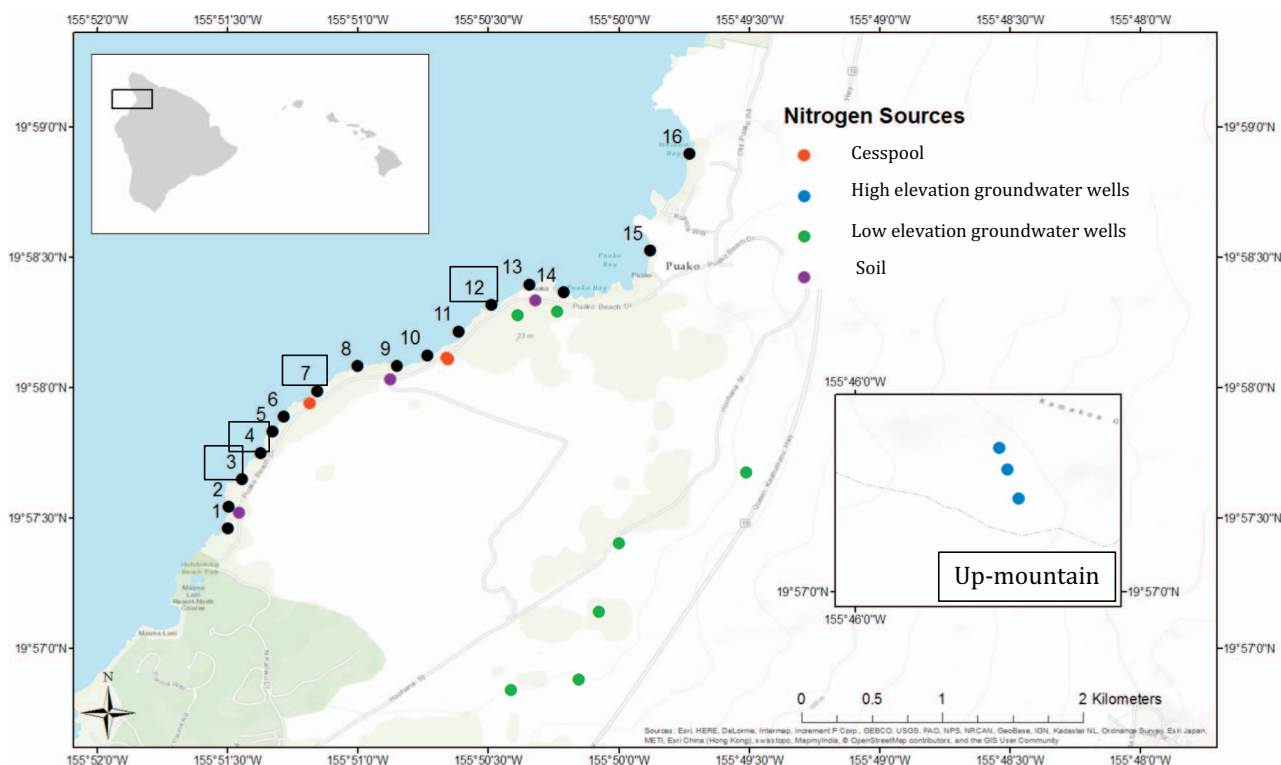


Fig. 1. Samples for fecal indicator bacteria (FIB), nutrients, $\delta^{15}\text{N}$ in macroalgae, and physiochemical parameters were taken from 16 stations along the Puako coastline, Hawaii (black circles). Dye tracer studies were conducted in close proximity to the stations outlined with squares. Nitrogen sources sampled include cesspools, high and low elevation groundwater wells, and soil (colored circles). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

(60–70 m of shoreline), representing three to four groundwater springs of varying salinity, and two stations with higher salinity and no apparent freshwater input. Water samples were collected at each station before and during dye tracer studies in opaque brown high density polyethylene bottles to prevent photodegradation, pre-rinsed with sample water, and stored at 4 °C until analysis. During the first 12 h of the dye study, samples were collected every 2 h to identify any fast-flow pathways. Afterwards, two samples were collected at each station within an hour of the lowest-low tide each day for up to 14 d.

To quantify the concentration of fluorescein, samples were brought to room temperature, filtered (Whatman™ GF/F), and analyzed using a Turner AU10 fluorometer in the dark. The detection limit for our analysis was 0.95 ppb (USEPA 40 CFR 2011). When salinity was not measured in the field, conductivity of samples was measured in the laboratory (Orion Star) and converted to PSS-78 salinity (UNESCO, 1981).

2.3. Shoreline station selection

To select shoreline stations for sewage pollution sampling, a salinity survey was conducted using a YSI 6600 V2 multi-parameter sonde interfaced with a Garmin etrex Global Positioning System. These shoreline stations were chosen prior to homes being identified for dye tracer studies. This was completed in the summer of 2014 during low tides to capture maximum SGD input. From this survey, 16 shoreline stations were chosen with varying salinity; four stations were coincidentally in front of properties where dye tracer tests were conducted (Fig. 1).

2.4. FIB and nutrient analyses

Triplicate water samples were collected in sterile, acid washed, polypropylene plastic bottles on four dates (November 2014, March, June, and July 2015) at each station and analyzed for FIB, nutrients, and salinity. Sample processing was conducted within 6 h of collection. Samples were taken during low tide when SGD is highest, and near

sunrise as sunlight reduces FIB survival (Fujioka et al., 1981). *Enterococcus* spp. was analyzed using the Enterolert MPN method (IDEXX Laboratories Inc.) following manufacturer's recommendations of 10 mL sample and 90 mL sterile water. The analytical range for this method is from 1 to 2419 MPN/100 mL. All *Enterococcus* spp. concentrations were corrected for sample dilution during analysis. When no wells fluoresced blue in the QuantiTray, *Enterococcus* spp. concentrations were reported as 5 MPN/100 mL, one-half the detection limit of the method after correcting for sample dilution. No diluted *Enterococcus* spp. concentrations exceeded the upper detection limit of the Enterolert MPN method. *C. perfringens* was enumerated by filtering 100 mL of sample water with 0.45- μm pore size cellulose nitrate filters (Whatman™) and mCP medium (Acumedia, Baltimore, MD, USA) (Bisson and Cabelli, 1979).

Water from one of the three samples was also filtered through a pre-combusted (500 °C for 6 h) filter (GF/F Whatman™), and stored frozen until analysis for nutrient concentrations at the University of Hawai'i at Hilo's (UH Hilo) Analytical Laboratory. Nutrients were analyzed on a Pulse Technicon™ II autoanalyzer using standard methods ($\text{NO}_3^- + \text{NO}_2^-$ [Detection Limit (DL) 0.07 $\mu\text{mol/L}$, USEPA 353.4], NH_4^+ [DL 0.36 $\mu\text{mol/L}$, USGS I-2525], PO_4^{3-} [DL 0.03 $\mu\text{mol/L}$, Technicon™ Industrial Method 155-71 W], total dissolved phosphorous (TDP) [DL 0.5 $\mu\text{mol/L}$, USGS I-4650-03], H_4SiO_4 [DL 1 $\mu\text{mol/L}$, USEPA 366]), and reference materials (NIST; HACH 307-49, 153-49, 14242-32, 194-49). Total dissolved nitrogen (TDN) was analyzed by high-temperature combustion, followed by chemiluminescent detection of nitric oxide (DL 5 $\mu\text{mol/L}$, ASTM D5176, Shimadzu TOC-V, TNM-1) (Sharp et al., 2002). Salinity was measured at the time of water collection using a YSI Pro 2030 multi-parameter probe.

2.5. $\delta^{15}\text{N}$ analyses

At the time of water sample collection, macroalgae with sufficient biomass to harvest were collected (~5 g) at all stations and analyzed for

$\delta^{15}\text{N}$ (Fig. 1). Multiple species were collected at each station because a common macroalgal species did not exist among them. The number of species collected varied with station. Macroalgal tissues were placed on ice during transport to the laboratory, where tissues were rinsed with deionized water. Subsamples of macroalgae were preserved as voucher specimens and identified to the lowest taxonomic resolution using an Olympus™ CH30 microscope (Abbott, 1999; Abbott and Huisman, 2004). The remaining algal tissues from each station were combined for a composite sample. These tissues were dried at 60 °C until a constant weight was achieved, ground and homogenized using a Wig-L-Bug grinding mill, and ~2 mg of the macroalgal tissue were folded in 4 × 6 mm tin capsules for stable isotope analysis. Macroalgal tissues were analyzed for $\delta^{15}\text{N}$ using a Thermo-Finnigan™ Delta V Advantage isotope ratio mass spectrometer (IRMS) with a ConFlo III interface and a Costech™ ECS 4010 Elemental Analyzer located at the UH Hilo's Analytical Laboratory. Data were normalized to United States Geological Service (USGS) standard NIST 1547. Isotopic signatures are expressed as standard (δ) values, in units of parts per mil (‰), and calculated as $[(R_{\text{sample}} - R_{\text{standard}}) / R_{\text{standard}}] \times 1000$, where $R = {}^{15}\text{N}/{}^{14}\text{N}$.

To determine the sources of N being used by the macroalgae, $\delta^{15}\text{N}$ - NO_3^- of potential sources were measured. Nutrient concentrations ($\text{NO}_3^- + \text{NO}_2^-$, NH_4^+ , and PO_4^{3-}) in these sources were also quantified. Sources sampled included: cesspools (n = 3), high elevation drinking water wells (n = 3), low elevation irrigation wells (n = 7), ambient seawater (n = 2), and soil (n = 3) from under Kiawe trees (*Prosopis pallida*). Kiawe is an introduced N_2 -fixing tree found widely on the leeward coast of Hawai'i Island, and contributes N to soil and groundwater (Dudley et al., 2014). Soil was collected directly under the Kiawe trees, dried, and then shaken overnight with reagent-grade water. N source water samples were collected at several locations to encompass spatial variability within Puakō's watershed. All N source samples were filtered through a 0.22- μm cellulose acetate filter (Whatman™) and frozen until analysis. $\delta^{15}\text{N}$ - NO_3^- samples were analyzed on a Thermo-Finnigan™ Delta Plus IRMS with data normalized to USGS standards (USGS32, USGS34, USGS53) at Northern Arizona University's Colorado Plateau Stable Isotope Laboratory. IAEA-NO3 was used as a check standard. Fertilizer values used in this study were from a previous study on Hawai'i Island (Wiegner et al., 2016). To determine their N sources, the $\delta^{15}\text{N}$ macroalgal tissue values were plotted relative to $\delta^{15}\text{N}$ source values (Derse et al., 2007; Wiegner et al., 2016).

2.6. Data analyses

To determine if FIB, nutrients, and $\delta^{15}\text{N}$ values in macroalgal tissue differed among stations, a one-way analysis of variance (ANOVA) was used for each variable. Correlations were used to evaluate associations between FIB, nutrients, $\delta^{15}\text{N}$ values, and other water quality parameters. Data were tested for normality and equal variances. If assumptions were not met for parametric analyses, log transformations were used. All statistical analyses were conducted using Minitab17 (2010) with $\alpha = 0.05$.

Nutrient concentration data on mixing plots were compared to a theoretical mixing line connecting the freshwater and ocean end members. When nutrient concentration data overlaid the mixing line, the nutrient was characterized as having conservative behavior, where only dilution with seawater is affecting the nutrient concentration in the nearshore waters. When data fell above or below the mixing line, the nutrient was described as behaving non-conservatively, with some source adding the nutrient to the water or some process removing it during mixing.

3. Results

3.1. Dye tracer studies

Dye was visually observed at the shoreline in front of all four homes. Of the three to four springs sampled during each test, dye only appeared

at one of the springs at the shoreline in front of the property with the OSDS being tested. The SGD at these springs dispersed over an area between 0.25 and 4 m^2 . Initial dye breakthrough at the shoreline, calculated from the difference in time from when the dye was added to the OSDS until its first appearance at the shoreline, ranged from 9 h to 3 d. Three of the homes had comparable flow rates between 4 and 14 m/d ; the OSDS at one home was faster, where dye in SGD traveled 76 m/d . Based on dye dilution, the maximum fraction of sewage in the fresh-water at the shoreline varied from < 0.02 to 0.14%, depending on how much mixing occurred before discharge at the shoreline.

3.2. Sewage indicators

Contrasting patterns were seen among sewage indicators along shoreline stations. *Enterococcus* spp. concentrations ranged from 18 to 2777 MPN/100 mL, and significantly differed among stations ($p = 0.04$), with station 13 having the highest values, which were two times, to one or two orders of magnitude larger than other stations (Fig. 2, Table 1). *C. perfringens* concentrations ranged from 2 to 12 CFU/100 mL, and were similar among stations, averaging (mean \pm SE) 5 ± 3 CFU/100 mL across all stations ($p = 0.06$) (Fig. 2, Table 1). The most prevalent macroalgal species along the shoreline were *Ulva fasciata*, *Cladophora* spp., and *Gelidium acerosa*. The $\delta^{15}\text{N}$ in macroalgal tissue ranged from 4.23 to 11.88‰ across all stations, and significantly differed among stations ($p < 0.0001$) (Fig. 2, Table 1), with stations 3 and 4 having the highest values (Fig. 2). Six out of 16 stations fell

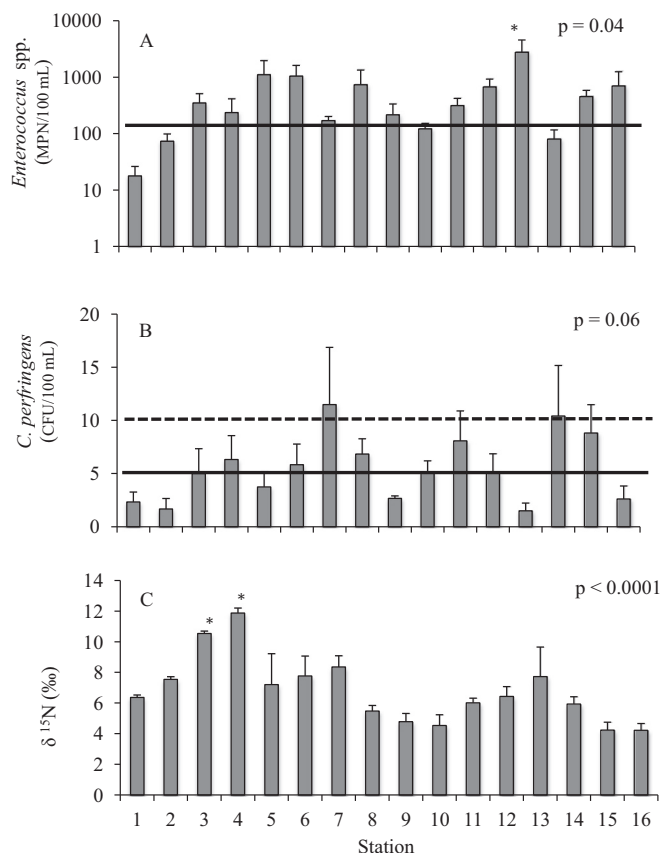


Fig. 2. Mean \pm SE of sewage indicators: (A) *Enterococcus* spp., (B) *Clostridium perfringens*, and (C) $\delta^{15}\text{N}$ (‰) of wild macroalgae at 16 shoreline stations at Puakō, Hawai'i. Hawai'i's Department of Health single sample maximum for *Enterococcus* spp. (104 CFU/100 mL, Fujioka et al., 1997) and a recommended marine recreational standard for *C. perfringens* (5 CFU/100 mL, Fung et al., 2007) are indicated by black lines. The dashed black line represents the lowest benchmark level for non-point sewage pollution for *C. perfringens* (10 CFU/100 mL, Fung et al., 2007). Results from One-way ANOVA and Tukey's tests are shown on the figure, with * indicating significant differences ($\alpha = 0.05$).

Table 1

Mean ± SE and [range] of *Enterococcus* spp., *Clostridium perfringens*, and δ¹⁵N in macroalgal tissues for shoreline stations at Puakō, Hawai'i. Superscript letters indicate significant groupings from One-way ANOVA and post-hoc Tukey's tests. α = 0.05; n = 4 samplings.

Station	<i>Enterococcus</i> spp. (MPN/100 mL)	<i>C. perfringens</i> (CFU/100 mL)	δ ¹⁵ N (‰)
1	18 ± 8 ^b [9–43]	2 ± 1 [0–4]	6.38 ± 0.15 ^{a-c} [6.03–6.65]
2	74 ± 25 ^{ab} [37–143]	2 ± 1 [0–4]	7.54 ± 0.18 ^{a-c} [7.04–7.90]
3	349 ± 162 ^{ab} [37–739]	5 ± 2 [1–10]	10.55 ± 0.15 ^{ab} [10.37–11.00]
4	237 ± 178 ^{ab} [47–770]	6 ± 2 [3–13]	11.88 ± 0.32 ^b [11.27–12.78]
5	1107 ± 861 ^{ab} [94–3674]	4 ± 1 [0–6]	7.21 ± 0.21 ^{a-c} [1.29–10.26]
6	1051 ± 570 ^{ab} [72–2546]	6 ± 2 [2–10]	7.77 ± 1.30 ^{a-c} [4.15–10.18]
7	170 ± 32 ^{ab} [104–257]	12 ± 5 [3–27]	8.35 ± 0.74 ^{a-c} [6.48–9.80]
8	738 ± 603 ^{ab} [62–2544]	7 ± 1 [3–10]	5.48 ± 0.37 ^{a-c} [5.06–6.58]
9	216 ± 120 ^{ab} [27–563]	3 ± 0 [2–3]	4.79 ± 0.53 ^{bc} [3.85–6.18]
10	122 ± 30 ^{ab} [66–202]	5 ± 1 [2–7]	4.54 ± 0.70 ^c [3.57–6.56]
11	315 ± 107 ^{ab} [15–495]	8 ± 3 [2–14]	6.02 ± 0.30 ^{a-c} [5.59–6.91]
12	676 ± 251 ^{ab} [121–1323]	5 ± 2 [2–8]	6.43 ± 0.65 ^{a-c} [4.90–8.04]
13	2777 ± 1806 ^a [17–7985]	2 ± 1 [0–3]	7.74 ± 1.92 ^{a-c} [4.80–13.12]
14	80 ± 36 ^{ab} [24–185]	10 ± 5 [1–20]	5.94 ± 0.47 ^{a-c} [5.08–7.28]
15	454 ± 132 ^{ab} [180–816]	9 ± 3 [2–13]	4.24 ± 0.51 ^c [3.62–5.77]
16	699 ± 554 ^{ab} [17–2338]	3 ± 1 [0–6]	4.23 ± 0.44 ^c [3.53–5.50]

within the sewage δ¹⁵N - NO₃⁻ range (9.62 to 11.57‰) (Table 2), including stations 3, 4, 5, 6, 7, and 13 (Fig. 3). The remaining stations fell within the high and low elevation groundwater ranges (Fig. 3). NO₃⁻ + NO₂⁻ concentrations were ~40 μmol/L lower in high elevation wells compared to the lower elevation ones (Table 2). In addition, PO₄³⁻ and NH₄⁺ concentrations were similar between high and low elevation wells (Table 2). NO₃⁻ + NO₂⁻, TDN, PO₄³⁻, TDP, and H₄SiO₄ concentrations significantly differed among shoreline stations (p < 0.001) (Table 3). Station 4 had the highest concentrations, and station 15 had the lowest concentrations for all nutrients, except H₄SiO₄. H₄SiO₄ concentrations were highest at station 14, which was ~500 μmol/L higher than the lowest measured concentration (Table 3). NH₄⁺ concentrations were similar across all stations (p > 0.06). Salinity also varied across stations (p < 0.01), with stations 2 and 14 being the freshest (Table 3). Nutrient concentrations (NO₃⁻ + NO₂⁻, TDN, PO₄³⁻, TDP, and H₄SiO₄) were also inversely correlated with salinity (p < 0.01). Mixing plot analysis revealed conservative mixing of groundwater-derived nutrients (NO₃⁻ + NO₂⁻, TDN, PO₄³⁻, TDP, and H₄SiO₄) with seawater, except for a few stations that consistently

Table 2

Mean ± SE of δ¹⁵N - NO₃⁻ (‰) and NO₃⁻ + NO₂⁻, PO₄³⁻, and NH₄⁺ concentrations (μmol/L) of N sources collected in the Puakō watershed, Hawai'i. (n = sample size).

N Source	n	δ ¹⁵ N-NO ₃ ⁻	NO ₃ ⁻ + NO ₂ ⁻	NH ₄ ⁺	PO ₄ ³⁻
Cesspools	3	10.45 ± 0.58	20.76 ± 10.50	6370.00 ± 806.16	378.58 ± 16.59
Soil	3	2.13 ± 2.37	6366.67 ± 3682.46	594.54 ± 93.23	193.56 ± 141.56
Ocean	2	3.02 ± 0.79	1.43 ± 0.08	2.52 ± 0.55	0.11 ± 0.05
High elevation groundwater wells	3	4.76 ± 0.43	93.87 ± 4.35	4.84 ± 1.43	2.48 ± 0.19
Low elevation groundwater wells	7	7.03 ± 0.50	130.09 ± 6.70	4.82 ± 1.19	2.48 ± 0.19
Shoreline	3	11.95 ± 1.13	133.93 ± 64.68	1.47 ± 0.44	5.27 ± 1.57

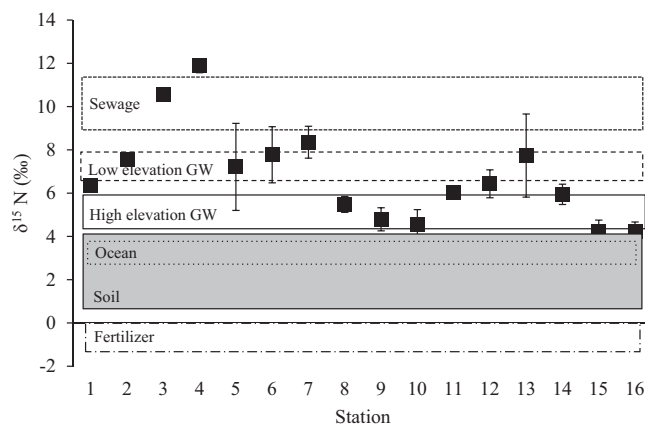


Fig. 3. Mean ± SE δ¹⁵N (‰) of wild macroalgae found at 16 stations in Puakō, Hawai'i. Background areas represent (mean ± SE) δ¹⁵NO₃⁻ of the N sources (fertilizer, soil, ocean, high elevation groundwater (GW) wells, low elevation GW wells, and sewage) measured as part of this study. Fertilizer values are from a previous study on Hawai'i Island (Wiegner et al., 2016).

fell well above the theoretical mixing line (Fig. 4). These included stations 3, 4, and 7. NH₄⁺ displayed non-conservative mixing (Fig. 4).

3.3. Associations between sewage indicators

Most sewage indicators were not correlated with each other. However, *C. perfringens* was positively correlated with NH₄⁺ (p = 0.02) (Fig. 5), and δ¹⁵N in macroalgal tissues was positively correlated with NO₃⁻ + NO₂⁻ (p < 0.001), TDN (p < 0.001), and PO₄³⁻ concentrations (p < 0.001) (Fig. 6).

4. Discussion

4.1. Sewage indicators

FIB are used by federal and state regulatory agencies to identify impaired recreational waters. At Puakō, *Enterococcus* spp. concentrations were highly variable across both space and time, with station 13 having the highest values. Additionally, when comparing our average values of *Enterococcus* spp. concentrations to Hawai'i Department of Health's (HDOH) single sample maximum of 104 CFU/100 mL, 13 out of 16 stations exceeded this threshold, with the majority of these stations exceeding it two to three of the four sampling times, and two stations exceeding it on all four occasions (Fig. 2). However, *Enterococcus* spp. concentrations have been shown to vary spatially, temporally, seasonally, and to be tidally influenced (Shibata et al., 2004; Maiga et al., 2009; Shibata et al., 2010; Nnane et al., 2011; Converse et al., 2012). In addition, *Enterococcus* spp. can persist in tropical soils and come from different animal sources (Hardina and Fujioka, 1991; Byappanahalli and Fujioka, 1998; Byappanahalli and Fujioka, 2004; Ragosta et al., 2010), and thus, may not be indicative of sewage. However, soils are an unlikely source of *Enterococcus* spp. at Puakō as the area generally lacks soil, the substratum is primarily

Table 3

Mean \pm SE and [range] of $\text{NO}_3^- + \text{NO}_2^-$, NH_4^+ , TDN, PO_4^{3-} , TDP, H_4SiO_4 concentrations ($\mu\text{mol/L}$), and salinity for shoreline stations at Puakō, Hawai'i. Superscript letters indicate significant groupings from One-way ANOVA and post-hoc Tukey's tests. $\alpha = 0.05$; $n = 4$ samplings.

Station	$\text{NO}_3^- + \text{NO}_2^-$	NH_4^+	TDN	PO_4^{3-}	TDP	H_4SiO_4	Salinity
1	27.87 \pm 4.09 ^{b-e} [18.10–36.79]	0.83 \pm 0.15 [0.78–1.23]	41 \pm 7 ^{c-f} [25–58]	0.44 \pm 0.04 ^{fg} [0.33–0.51]	0.7 \pm 0.1 ^{fg} [0.5–1.0]	133 \pm 23 ^{a-c} [87–195]	27.58 \pm 1.44 ^{a-c} [23.63–30.37]
2	149.94 \pm 12.79 ^{ab} [129.62–187.09]	0.49 \pm 0.11 [0.18–0.72]	159 \pm 13 ^{ab} [139–195]	2.24 \pm 0.24 ^{a-d} [1.62–2.73]	2.9 \pm 0.3 ^{a-e} [2.2–3.5]	581 \pm 155 ^{ab} [187–876]	7.12 \pm 0.61 ^e [5.77–8.70]
3	137.12 \pm 35.39 ^{a-c} [36.22–190.37]	1.95 \pm 0.30 [1.04–2.29]	154 \pm 39 ^{a-c} [41–217]	3.81 \pm 0.92 ^{ab} [1.34–5.37]	4.3 \pm 0.7 ^{ab} [2.4–5.1]	377 \pm 124 ^{a-c} [112–646]	16.26 \pm 3.96 ^{b-e} [9.50–25.73]
4	196.05 \pm 28.14 ^a [125.66–263.07]	1.30 \pm 0.05 [1.24–1.47]	221 \pm 26 ^a [153–267]	7.42 \pm 1.11 ^a [4.12–9.00]	8.3 \pm 1.4 ^a [4.5–10.8]	501 \pm 113 ^{ab} [172–683]	15.25 \pm 2.30 ^{c-e} [9.10–20.20]
5	46.92 \pm 8.73 ^{a-e} [23.44–65.52]	1.32 \pm 0.16 [0.86–1.57]	70 \pm 12 ^{a-f} [42–87]	1.34 \pm 0.17 ^{b-f} [0.90–1.71]	1.7 \pm 0.3 ^{b-f} [0.9–2.1]	179 \pm 41 ^{a-c} [85–278]	24.98 \pm 2.35 ^{a-d} [19.70–31.07]
6	26.78 \pm 11.48 ^{de} [2.50–54.16]	1.22 \pm 0.10 [1.03–1.46]	44 \pm 16 ^{d-f} [23–86]	0.66 \pm 0.21 ^{e-g} [0.25–1.17]	0.9 \pm 0.2 ^{fg} [0.3–1.3]	95 \pm 43 ^c [22–219]	30.77 \pm 2.31 ^a [24.53–35.53]
7	134.56 \pm 54.94 ^{a-d} [42.27–285.74]	1.69 \pm 0.65 [0.46–2.90]	131 \pm 43 ^{a-d} [53–241]	3.08 \pm 0.44 ^{a-c} [2.12–3.83]	3.4 \pm 0.5 ^{a-c} [2.2–4.5]	447 \pm 132 ^{ab} [164–804]	21.98 \pm 0.97 ^{a-d} [19.87–24.03]
8	39.15 \pm 14.53 ^{c-e} [0.99–67.10]	2.40 \pm 0.97 [1.00–0.33]	59 \pm 19 ^{b-f} [12–99]	0.70 \pm 0.23 ^{e-g} [0.52–1.07]	1.0 \pm 0.2 ^{e-g} [0.6–1.6]	253 \pm 83 ^{a-c} [31–416]	20.60 \pm 4.90 ^{a-d} [14.10–35.17]
9	69.74 \pm 9.06 ^{a-e} [47.81–91.92]	1.00 \pm 0.33 [0.89–1.77]	85 \pm 7 ^{a-e} [74–105]	1.37 \pm 0.13 ^{b-f} [1.15–1.73]	1.8 \pm 0.2 ^{b-f} [1.5–2.3]	342 \pm 90 ^{a-c} [219–609]	15.28 \pm 2.31 ^{cd} [8.53–18.53]
10	56.72 \pm 17.48 ^{a-e} [11.59–94.94]	0.95 \pm 0.27 [0.47–1.51]	73 \pm 19 ^{b-f} [20–106]	1.14 \pm 0.31 ^{e-g} [0.34–1.84]	1.5 \pm 0.2 ^{b-f} [1.2–1.8]	354 \pm 76 ^{a-c} [129–445]	15.03 \pm 3.60 ^{de} [4.90–21.90]
11	16.52 \pm 1.21 ^{de} [14.08–18.73]	0.96 \pm 0.30 [0.18–1.45]	29 \pm 4 ^{ef} [23–41]	0.49 \pm 0.04 ^{e-g} [0.40–0.58]	0.8 \pm 0.2 ^{fg} [0.3–1.3]	108 \pm 27 ^{bc} [53–173]	18.30 \pm 0.93 ^{ab} [26.07–30.60]
12	35.80 \pm 4.37 ^{a-e} [25.62–46.59]	1.34 \pm 0.25 [0.78–1.88]	46 \pm 5 ^{b-f} [34–56]	0.99 \pm 0.11 ^{e-g} [0.40–1.31]	1.3 \pm 0.3 ^{e-g} [0.9–2.1]	260 \pm 105 ^{a-c} [112–568]	24.50 \pm 0.96 ^{a-d} [22.57–27.13]
13	34.89 \pm 4.73 ^{a-e} [22.54–44.18]	1.21 \pm 0.19 [0.73–1.56]	49 \pm 7 ^{b-f} [35–67]	1.64 \pm 0.28 ^{b-e} [0.91–2.29]	1.9 \pm 0.2 ^{b-f} [1.7–2.4]	207 \pm 23 ^{a-c} [167–267]	23.96 \pm 2.00 ^{a-d} [19.90–28.27]
14	89.08 \pm 5.48 ^{a-d} [75.93–101.22]	1.15 \pm 0.29 [0.64–1.54]	101 \pm 7 ^{a-d} [84–117]	2.61 \pm 0.17 ^{a-c} [2.22–2.98]	2.9 \pm 0.3 ^{a-d} [2.4–3.6]	652 \pm 174 ^a [359–1018]	6.43 \pm 0.63 ^e [5.33–8.07]
15	13.37 \pm 2.80 ^e [5.73–19.24]	1.07 \pm 0.17 [0.75–1.44]	22 \pm 3 ^f [15–27]	0.39 \pm 0.09 ^g [0.16–0.55]	0.6 \pm 0.2 ^g [0.3–1.1]	120 \pm 24 ^{a-c} [52–158]	29.94 \pm 0.70 ^a [28.67–31.27]
16	38.50 \pm 7.20 ^{a-e} [17.35–47.44]	0.63 \pm 0.31 [0.18–1.51]	46 \pm 4 ^{c-f} [34–52]	0.81 \pm 0.13 ^{d-g} [0.45–1.09]	1.1 \pm 0.3 ^{d-g} [0.6–2.0]	323 \pm 86 ^{a-c} [142–552]	17.13 \pm 3.44 ^{b-e} [7.94–24.53]

basal, and shoreline concentrations were extremely high compared to state standards. While *C. perfringens* concentrations did not vary among stations, 11 of the 16 stations fell above the recommended standard to HDOH for marine recreational waters (5 CFU/100 mL) (Fujioka et al., 1997). Additionally, using the Fung/Fujioka *C. perfringens* scale for sewage pollution based on single sample maximums (Fung et al., 2007), only four of our stations (stations 7, 11, 14, and 15) were indicative of non-point sewage contamination (> 10 CFU/100 mL). The remaining five stations fell below this range, and were classified as not being polluted by sewage. While only certain stations had *C. perfringens* concentrations within the range for non-point sewage pollution, the correlation between *C. perfringens* and NH_4^+ suggest that sewage pollution may be more pervasive, as these two parameters are associated with anaerobic conditions, which are often found in OSDS.

While FIB are used to detect sewage, their application is primarily for assessing human health hazards for recreational water users. In comparison, $\delta^{15}\text{N}$ values in macroalgal tissues are used to determine N sources to coastal waters including sewage (Costanzo et al., 2005; Lapointe et al., 2005; Savage, 2005; Derse et al., 2007; Dailer et al., 2012). Typical sewage values range from +5 to +20‰ (reviewed in Wiegner et al., 2016), and values from cesspools in our study fell within this range (Table 3). $\delta^{15}\text{N}$ in macroalgal tissues along the Puakō shoreline ranged from 4.23 to 11.88‰, with six out of 16 shoreline stations falling within the range for sewage (Table 4). Stations 3 and 4 had the most enriched $\delta^{15}\text{N}$ macroalgal tissues, highlighting two potential sewage pollution hotspots. However, past studies have found that macroalgae assimilate N more rapidly under low NO_3^- concentrations (Fujita, 1985), and that $\delta^{15}\text{N}$ in macroalgal tissue can be underestimated by up to 6‰ in waters with high NO_3^- concentrations (> 10 $\mu\text{mol/L}$) (Swart et al., 2014). All of the stations had $\text{NO}_3^- + \text{NO}_2^-$ concentrations exceeding 10 $\mu\text{mol/L}$, suggesting that the $\delta^{15}\text{N}$ macroalgal values may be underestimated. If this was the case, then all 16 stations fall within the sewage range. In contrast, other

studies have found that tissue from opportunistic macroalgae reflects the nutrient concentrations in the water column (Fong et al., 1994). These macroalgae are often used as bioindicators as their tissues respond rapidly to N inputs (Duarte, 1995; Cohen and Fong, 2006). Two out of the three taxa (*U. fasciata*, *Cladophora* spp.) collected along the Puakō shoreline were opportunistic macroalgae. Opportunistic macroalgae taxa were not present at every station, possibly due to heavy grazing in the area. Hence, composite algal samples were analyzed, which included tissue from *G. acerosa*, a non-opportunistic species. Additionally, $\text{NO}_3^- + \text{NO}_2^-$, TDP, PO_4^{3-} , and TDN concentrations were nearly eight times greater at station 4 compared to all stations; this pattern was also seen with $\delta^{15}\text{N}$ in macroalgal tissues. These results further suggest that station 4 is a hotspot of non-point sewage pollution at Puakō. The significant positive correlation between $\delta^{15}\text{N}$ in macroalgae and nutrient concentrations further suggest that some portion of the nutrients' concentrations are derived from sewage (Fig. 6).

4.2. Hydrology

At Puakō, a large portion of the nutrient concentration data for $\text{NO}_3^- + \text{NO}_2^-$, TDN, PO_4^{3-} , and TDP fell on the theoretical mixing line, with highest concentrations at the lowest salinities. This result suggests that high elevational groundwater is a source of nutrients to Puakō's coastal waters and that they are behaving conservatively as groundwater and ocean water mix at the shoreline. This pattern, in part, explains the lack of associations between sewage indicators and salinity, as a large portion of groundwater nutrients discharging at the shoreline is from a nutrient source other than sewage. The conservative mixing nutrient patterns observed at Puakō have been documented elsewhere on Hawai'i Island in coastal areas with SGD (Knee et al., 2008b; Knee et al., 2010).

In contrast to the majority of our shoreline stations, data for stations 3, 4, and 7 consistently fell above the theoretical mixing line,

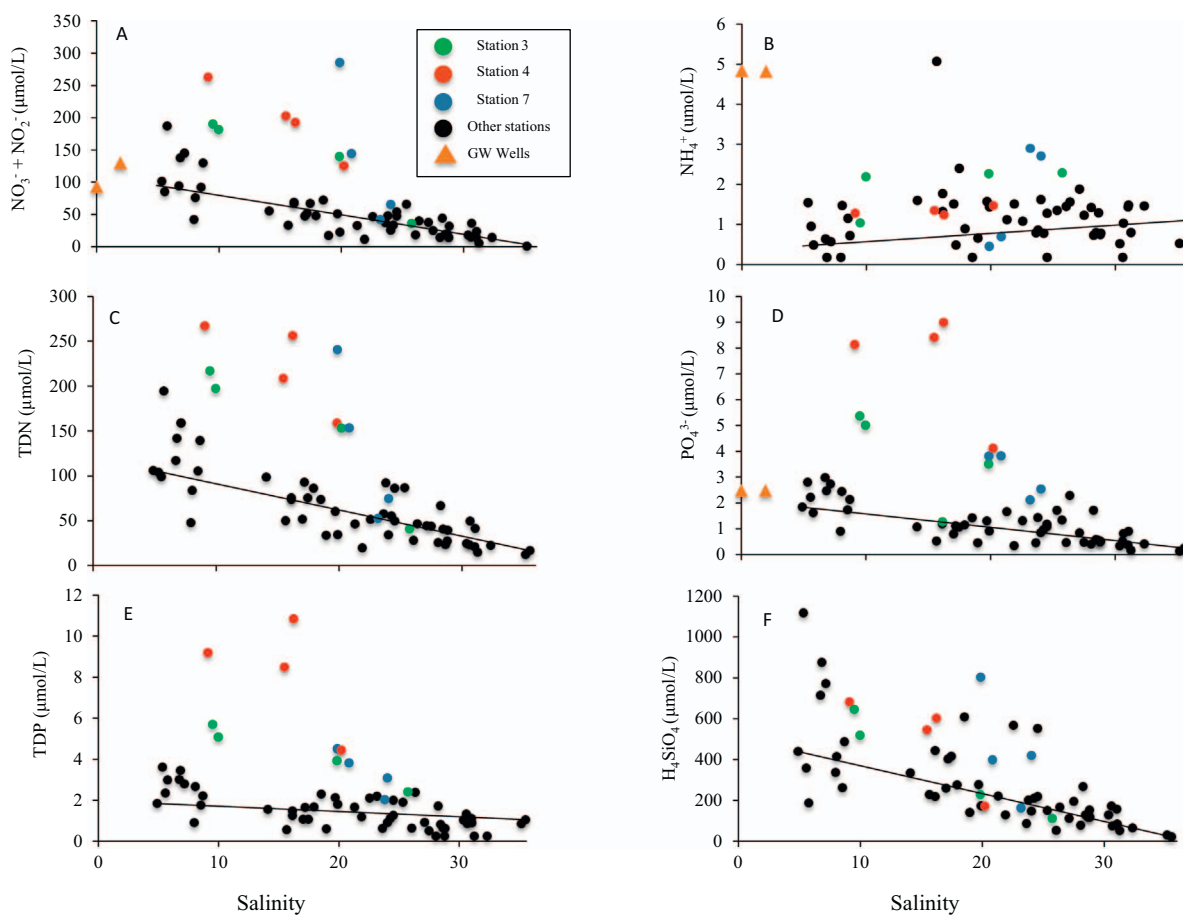


Fig. 4. Mixing plots of nutrient concentrations and salinity along the Puakō shoreline, Hawaii: (A) $\text{NO}_3^- + \text{NO}_2^-$, (B) NH_4^+ , (C) TDN, (D) PO_4^{3-} , (E) TDP, and (F) H_4SiO_4 . Line represents theoretical mixing line, connecting freshest and saltiest shoreline samples. Groundwater samples from wells were only analyzed for $\text{NO}_3^- + \text{NO}_2^-$, NH_4^+ , and PO_4^{3-} .

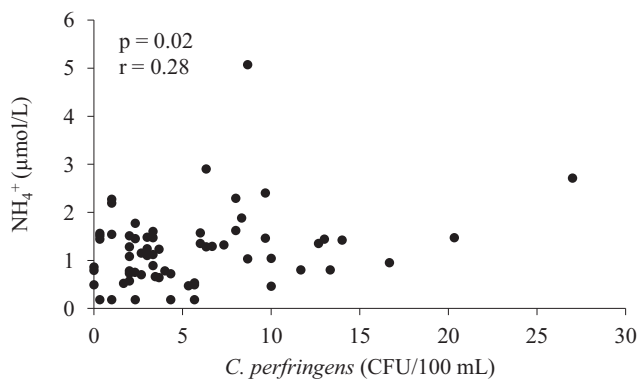


Fig. 5. Correlation between *Clostridium perfringens* and NH_4^+ along the Puakō shoreline, Hawaii.

suggesting there is a localized source of nutrients in those areas. The likely source is the OSDS as our dye tracer studies demonstrated that OSDS at these stations were leaking, and that the travel time from the homes to the shoreline was 9 h to 3 d. Additionally, dye was only observed seeping out during low tide and was localized within 10 m (longshore direction) of the shoreline. $\delta^{15}\text{N}\text{-NO}_3^-$ at these shoreline stations clearly fell within our measured $\delta^{15}\text{N}\text{-NO}_3^-$ sewage range at Puakō (Table 2), as did the $\delta^{15}\text{N}$ in the macroalgal tissue (Fig. 3). These results provide insight to the hydrology and geology at Puakō, where the fracture system within the basalt determines the flow path of the sewage from the OSDS to the shoreline, and affects the time of travel. Two other factors affecting sewage inputs are weather and house

occupancy. On the only rainy sampling day during this study (March 4, 2015), all three stations (3, 4, and 7) fell above the mixing line. This result illustrates that precipitation inputs may enhance the connection between the OSDS with the shoreline seeps through increased SGD. In contrast, there were some sampling dates on which nutrient concentrations for stations 3 and 7 fell on the mixing line. We suspect that on these dates, homes at these stations were not occupied, and therefore, their OSDS were not being used.

The $\delta^{15}\text{N}\text{-NO}_3^-$ and NO_3^- concentration data from the groundwater wells and shoreline stations also provided another insight into the hydrology of the Puakō watershed and coastal nutrient sources. The $\delta^{15}\text{N}\text{-NO}_3^-$ became increasingly enriched in ^{15}N moving downslope to the Puakō shoreline. The change in the $\delta^{15}\text{N}\text{-NO}_3^-$ from the high to low elevational groundwater wells suggests a change in NO_3^- source from forest soil to sewage. It is possible that sewage is contaminating the lower elevational groundwater as an upslope development (Waikoloa Village) has over 2000 homes with 1587 OSDS (per. Comm. Hawaii Water Supply). Additionally, NO_3^- concentrations increased ~ 40 mmol/L from the high to low elevational groundwater wells (Table 3). Lastly, the $\delta^{15}\text{N}$ enrichment in the $\delta^{15}\text{N}\text{-NO}_3^-$ from the lower elevational groundwater wells to the shoreline seeps suggests that additional sewage from Puakō homes is contaminating the groundwater before it is discharged along the shoreline. To understand the relative percent contributions of these two different communities to sewage pollution along Puakō's shoreline, more $\delta^{15}\text{N}\text{-NO}_3^-$ and $\delta^{18}\text{O}\text{-NO}_3^-$ data, as well as a mixing model capable of determining source contributions are needed (Wiegner et al., 2016). With this additional information, informed decisions about management actions can be made.

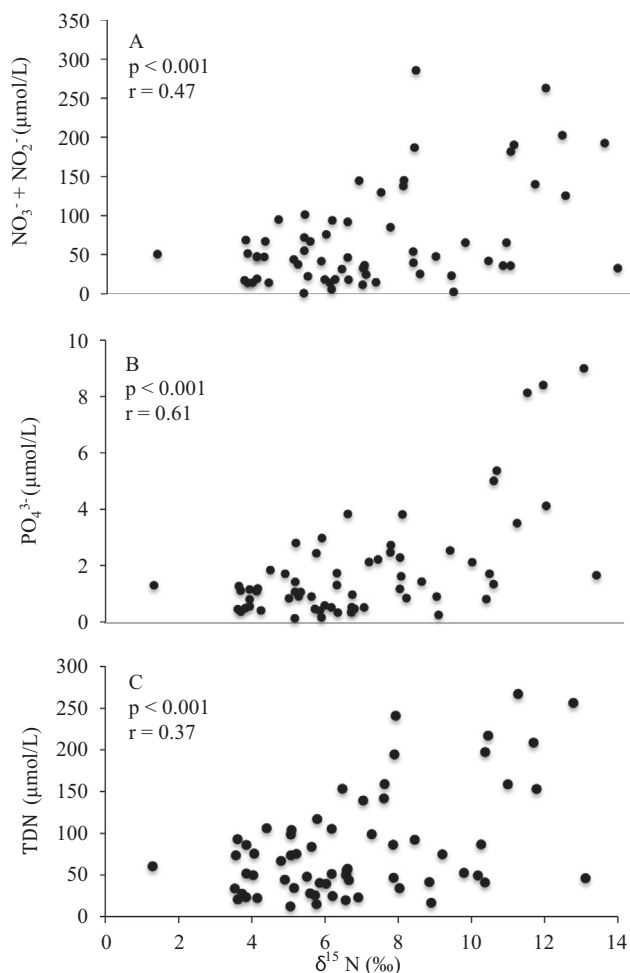


Fig. 6. Correlations between $\delta^{15}\text{N}$ in macroalgal tissues and nutrient concentrations: (A) $\text{NO}_3^- + \text{NO}_2^-$, (B) PO_4^{3-} , and (C) TDN along the Puakō shoreline, Hawai'i.

4.3. Development of a sewage pollution score

As this study and others have shown, sewage indicators can provide conflicting information on the intensity and location of sewage pollution along the shoreline. Previous studies have confronted similar issues with their sewage indicator data (Shibata et al., 2004; Yoshioka et al., 2016). Hence, creating a sewage pollution score using several sewage indicators may be a more holistic way to assess sewage pollution in coastal waters. Water quality scores and indices have been used successfully in the past to assess healthy water quality conditions for both humans and ecosystems (Zambrano et al., 2009; Wang et al., 2015). Interpolative mapping of water quality score or index values provides a simple and clear tool for managers and policymakers that allow them to relate human activities to water quality and identify areas in need of better management (Zambrano et al., 2009).

Table 4

Sewage indicators (fecal indicator bacteria = CFU/100 mL, $\delta^{15}\text{N}$ = ‰, and nutrients = $\mu\text{mol/L}$) used to evaluate water quality along the Puakō coastline, Hawai'i. These indicators were ranked (low = 1, medium = 2, and high = 3), multiplied by a weight factor, and summed for a final sewage pollution score. "Medium" nutrient concentration scores exceed HDOH standards (see Discussion for details).

Sewage indicator	Weight factor	Low (1)	Medium (2)*	High (3)	Reference
<i>Enterococcus</i> spp.	2	0–35	36–104	105+	HDOH, 2014
<i>Clostridium perfringens</i>	3	0–10	11–100	101–505+	Fung et al., 2007
$\delta^{15}\text{N}$ in macroalgae	3	0.00–5.99	6.00–10.99	11.00+	Current study
$\text{NO}_3^- + \text{NO}_2^-$	1	0.0–0.4	0.5–1.0	1.1–1.8+	HDOH, 2014
NH_4^+	1	0.00–0.25	0.26–0.61	0.62–1.07+	HDOH, 2014
TDP	1	0.0–0.7	0.8–1.3	1.4–1.9+	HDOH, 2014

To better assess sewage pollution conditions along the Puakō shoreline, a scoring tool was developed using three sewage indicators (FIB, $\delta^{15}\text{N}$ macroalgae, and nutrients). The scoring tool had three levels for each indicator: level 1 = low, level 2 = medium, and level 3 = high. Levels for each indicator were based on established standards, literature information, or data from this study (Table 4). Specifically, the scoring tool used HDOH's geometric mean and the single sample maximum for *Enterococcus* spp. concentrations in marine waters, the Fung/Fujioka *C. perfringens* scale for sewage pollution, $\delta^{15}\text{N}$ values in macroalgal tissues for different NO_3^- sources (Table 2), and HDOH's water quality standards for nutrient concentrations in open coastal waters ($\text{NO}_3^- + \text{NO}_2^-$, NH_4^+ , and TDP) (Table 4). Nutrient concentration standards for the wet criteria were used because the freshwater discharge along the Puakō shoreline ranged from 2083 to 2730 $\text{L m}^{-1} \text{h}^{-1}$ (Paytan et al., 2006), which are an order of magnitude larger than the baseline for the wet criteria ($> 294 \text{L m}^{-1} \text{h}^{-1}$). Two dissolved inorganic forms of N were chosen for the score tool rather than TDN because it contains DON, and sewage-derived DON's contribution to eutrophication is only beginning to be investigated (Pehlivanoglu and Sedlak, 2004; Urgun-Demirtas et al., 2008; Bronk et al., 2010; Filippino et al., 2011). TDP was used as the phosphorous water quality indicator since HDOH has no PO_4^{3-} water quality standard for open coastal waters (HDOH, 2014). It should also be noted that a medium level in nutrient concentrations exceeds HDOH standards for open coastal waters' wet criteria.

Once each indicator was assigned a level (1–3) based on its measured value and our scoring tool (Table 4), its level was multiplied by a weight factor (1–3), with the most reliable sewage indicators having the greatest weight. The greatest weight (weight = 3) was given to *C. perfringens* and $\delta^{15}\text{N}$ in macroalgal tissue because these indicators are more specific to sewage pollution, more integrative measurements of environmental conditions, and do not fluctuate as much as *Enterococcus* spp. and nutrient concentrations (Fung et al., 2007; Dailer et al., 2010; Viau et al., 2011; Yoshioka et al., 2016). *Enterococcus* spp. concentrations received a medium weight (weight = 2) as HDOH uses this FIB to assess marine recreational water safety specifically for sewage pollution, but not the highest weight because concentrations fluctuate over short time scales (min to h) and have other sources, like soils, in tropical areas (Hardina and Fujioka, 1991; Byappanahalli and Fujioka, 1998; Byappanahalli and Fujioka, 2004). Nutrient concentrations received the lowest weight (weight = 1) since sewage pollution is known to increase them, but nutrients can also come from other sources within the watershed and concentrations can vary over short time scales (Lapointe et al., 1990; David et al., 2013; Nelson et al., 2015). The equation for calculating the overall sewage pollution score for each station was: (*C. perfringens* level \times 3) + ($\delta^{15}\text{N}$ macroalgae level \times 3) + (*Enterococcus* spp. level \times 2) + ($\text{NO}_3^- + \text{NO}_2^-$ level \times 1) + (NH_4^+ level \times 1) + (TDP level \times 1). Sewage pollution score categories were: low = 11–17, medium = 18–25, and high = 26–33. The high end of the range for the low and medium sewage pollution score categories were calculated as the sum of low or medium scores for all indicators, respectively, except for nutrient concentrations, which were allowed to fluctuate up to the high level as inputs from non-sewage sources can result in high concentrations.

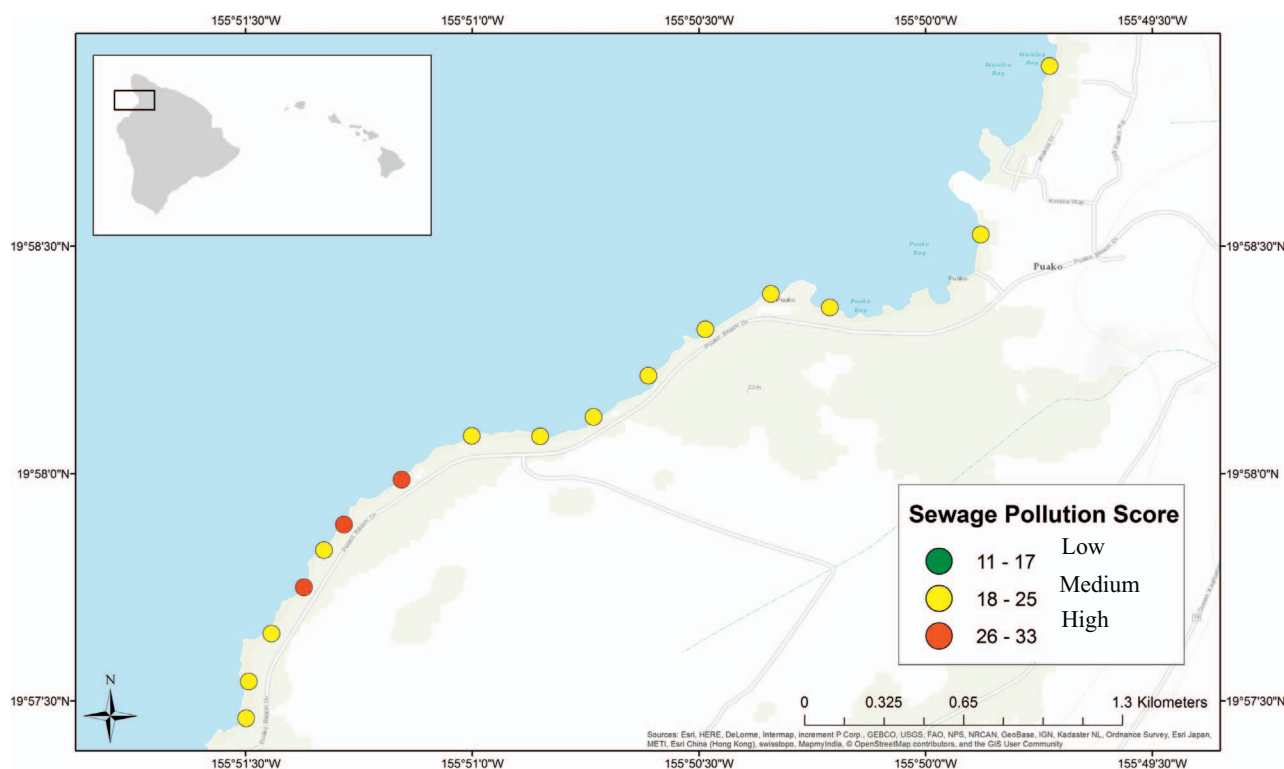


Fig. 7. Sewage pollution scores for 16 stations along the Puakō shoreline, Hawai'i, were based on established and recommended water quality standards, literature values for sewage indicators, and measured values from this study (fecal indicator bacteria, $\delta^{15}\text{N}$ in macroalgae, and nutrients). Sewage pollution score categories are: low = 11–17; medium = 18–25; high = 26–33. Details on the calculation of the sewage pollution score are provided in the Discussion section.

The stations with highest pollution sewage scores were stations 4 (score = 30), 6 (score = 26), and 7 (score = 27) (Fig. 7). Note, stations 4 and 7 are known locations of OSDS leakage from the dye tracer studies. These results confirm the effectiveness of our sewage pollution score in identifying hotspots of sewage pollution. Overall, three stations fell in the high category with the remainder in the medium category. This integrated approach identified sewage hotspots along the Puakō coastline, and locations where it is critical for homes to remove their cesspools and employ better sewage treatment technology. This map also provides information to the community on areas where residents and visitors may want to limit water exposure during recreational activities until sewage treatment is improved.

5. Conclusion

Globally, coral reefs are declining from multiple stressors, with sewage pollution being one of the most devastating (Wear and Vega Thurber, 2015). Dye tracer studies confirmed locations of sewage pollution and provided information on the time of travel from homes to the shoreline. FIB and nutrient concentrations were high and variable along the Puakō shoreline, and $\delta^{15}\text{N}$ in macroalgal tissue were within the sewage range. However, data from different indicators were not always in agreement with one another on the intensity and locations of sewage pollution. Hence, a novel pollution score was developed using these indicators to identify sewage hotspots. With sewage becoming a growing global threat in nearshore waters, being able to effectively assess its pollution is crucial for both human and marine ecosystem health. A multi-indicator approach for detecting sewage and this pollution scoring tool will allow other coastal communities to assess their water quality and take appropriate management actions, improving safety of recreational waters users and coastal ecosystem health.

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COUNTY OF HAWAI'I

**PROPOSED PUAKO COMMUNITY FACILITIES DISTRICT
DEPOSIT AND REIMBURSEMENT AGREEMENT**

THIS AGREEMENT is made and entered into this , 20 day of , , 2025, by and between the ~~County of Hawai'i~~ COUNTY OF HAWAI'I (the "County"), and , a PUAKO FOR REEFS, a Hawaii nonprofit corporation (the "Proponent"), ~~which owns the~~ comprised of members who own property within the boundaries of a proposed community facilities district.

RECITALS

- A. The State of Hawaii has mandated the closure of all cesspools in Hawai'i by 2050, and prioritized areas that pose the greatest threat to public health, safety, and welfare (Act 125, SLH 2017, codified as HRS section 342D-72). Puako, South Kohala, Hawaii is designated the highest Priority 1 due to the wastewater effluent impact to the high-value nearshore coral reefs caused by cesspools serving residences along Puako Beach Drive. The County has developed a Puako and South Kohala Regional Wastewater Master Plan (the "Master Plan") for the South Kohala region to enable the communities to meet the 2050 deadline, recognizing that the complexity and costs to meet the deadline is beyond the capabilities of each homeowner acting alone. Several marine studies have documented the significant decline in the health of Puako's nearshore coral reef with a decline of 90% in coral coverage from 70% to 7% within the past 50 years, attributed directly to the constituents of wastewater. Given the rate of decline, these studies establish an urgency to act within 10 years before the reef is irreversibly decimated.

- B. The Proponent was organized in recognition of the urgency to act to implement the Master Plan. The Proponent has taken it upon itself to raise seed money funds to start the arduous process to carry out the recommendations of the County's wastewater plan, so far raising commitments in private and state funding for the tasks involved in the planning phase. The Proponent is not a homeowners association (HOA) and the community does not have an HOA with mandatory membership which would have the authority to act on behalf of the homeowners. However, PFR has been working with the entire community for several years and is acting with wide support and will continue to outreach broadly throughout the process to garner the support of property owners required to form a Community Facilities District (CFD).

- C. Given the existing geographic conditions of Puako, the Master Plan recommended a low-pressure wastewater collection and transmission system (in lieu of a more costly gravity system) connecting to Hawai'i-American Water Company's existing private wastewater treatment plant at the Mauna Lani

Resort. This collection and transmission system would be the County's first low pressure system, as well as the first County system connecting to a private wastewater treatment plant, which raises complex first-impression issues. To enable the County to hire expertise to help address these complex issues, as well other issues involved with establishing a community-initiated CFD under the County's current CFD Guidelines, Proponent is willing to contribute the deposit referenced in this agreement.

AD. ~~The Proponent owns the real property that is included within~~ Defining the proposed boundaries of at the proposed community facilities district (the "Proposed District") ~~for the development known as _____ (the "Development Project")~~ in Puako, South Kohala, Hawai'i is another task to be addressed by the Proponent and the County. The Proposed District is proposed to be established pursuant to the provisions of Chapter 32 of the Hawai'i County Code, as amended ("Chapter 32") for financing the acquisition, construction and installation of "special improvements" (as defined in Chapter 32) (the "Special Improvements") which the Proponent is required to provide ~~in connection with the Development Project~~ to serve the Proposed District.

BE. The Proponent has agreed to advance funds to allow the County to pay all costs and expenses of the County related to addressing the threshold questions of defining the boundaries of the Proposed District, the type of wastewater collection and transmission system and integration with a private wastewater treatment plant, as well as proceedings ~~heretofore and~~ hereafter conducted for the establishment of the Proposed District and the issuance of special tax bonds for the Proposed District pursuant to Chapter 32 (the "Proposed Bonds").

F. The County has appropriated \$1,000,000 to create a revolving fund (the "Revolving Fund") to pay predevelopment costs for new county wastewater projects. The Proponent desires to have the County use the Revolving Fund to pay certain predevelopment costs.

CG. The parties hereto wish to enter into an agreement to define the terms and conditions under which the funds contributed by the Proponent will be advanced to address the threshold questions and subsequently be reimbursed.

AGREEMENT

In consideration of the mutual promises herein contained, the parties hereto do hereby agree as follows:

Section 1. Proponent's Deposit; Use of Deposited Funds.

(a) The Proponent agrees to deposit ~~initially~~ the sum of ~~[\$75,000]~~ (together with additional deposits hereunder, the "Deposit") with the County to pay one hundred percent (100%) of the costs and expenses of the County to address the threshold questions stated above and relating to the proceedings for the formation of the Proposed District and the issuance of the Proposed Bonds (collectively, the "County Deposit and Reimbursement Agreement

Costs”), including without limitation: (i) the fees and expenses of the County’s special tax consultant, financial advisor, appraiser, absorption consultant, legal counsel (including bond counsel and special tax counsel), consulting engineers and other professional consultants and advisors (individually a “Consultant” and collectively the “Consultants”); (ii) publication costs and other out-of-pocket expenses; (iii) a reasonable charge (if applicable) for County staff time; and (iv) other County staff and administrative costs.

(b) The County may draw upon the Deposit to pay the County Costs from time to time. Following use of the entire Deposit, the County shall use proceeds of the Revolving Fund to pay the County Costs. The County shall not be obligated to advance any of its funds other than the Revolving Fund for purposes of forming the Proposed District or the issuance and sale of the Proposed Bonds.

(c) In the event that the balance of the Deposit ~~falls below [\$20,000], or is and~~ the total amount of the Revolving fund are otherwise insufficient to pay any County Costs due or coming due, the Proponent shall deposit additional monies with the County in the amount necessary to ~~restore the balance of the Deposit to [\$75,000]~~ and/or pay the County Costs due or coming due. The Proponent shall deposit such additional monies within ten (10) calendar days of the receipt of written notification from the County of the need for such additional funds. Without limiting any other right of the County to discontinue proceedings relating to the Proposed District or the Proposed Bonds, it is expressly understood and agreed that the County shall have the right to suspend or terminate all proceedings for the establishment of the Proposed District and/or the issuance of the Proposed Bonds in the event that the Proponent fails to deposit such additional monies with the County within said ten (10) calendar days.

(d) The County shall provide monthly statements to the Proponent showing the amount disbursed from the Deposit and the remaining balance thereof. The County agrees to keep such records as are reasonably necessary to show the amount of monies disbursed for payment of County Costs. The County shall make such records available to the Proponent upon request.

Section 2. Consultants, Compensation, and Method of Payment. The County shall retain the Consultants upon such terms as it deems appropriate in its sole discretion. The County shall have the sole discretion to select the persons or firms to be retained as Consultants, and to evaluate their performance and the reasonableness of their compensation. Compensation shall be paid to each Consultant for work performed as specified in their respective contracts with the County. Upon request, the County shall provide the Proponent with a summary of fees paid to the Consultants on a bi-monthly basis.

Section 3. Reimbursement to Proponent. If the Proposed District is established and the Proposed Bonds are issued, the Proponent shall be entitled to be reimbursed for Deposit, without interest, from the proceeds of the Proposed Bonds. In the event that the net proceeds of the Proposed Bonds, after deducting the costs of issuance from the proceeds received by the County, are insufficient to fully fund both

(i) reimbursement of the Deposit and (ii) financing of the Special Improvements, the Proponent shall advise the County in writing whether it wishes to receive reimbursement of the Deposit or to waive its entitlement to such reimbursement. In the event that the Proposed Bonds are issued in multiple series, waiver of reimbursement with respect to a given series shall not constitute a waiver of reimbursement from the proceeds of any subsequent series. If the proceedings are abandoned for any reason prior to the sale and issuance of the Proposed Bonds, the obligation of the County to reimburse the Proponent for the Deposit or any portion thereof shall be strictly limited to that portion of the Deposit not yet expended, and the provisions of subsection (c) of Section 5 hereof shall govern the application of such unexpended portion of the Deposit.

Section 4. Ownership of Documents. All plans, specifications, reports, appraisals and other documentation prepared as part of the proceedings to establish the Proposed District and to sell and issue the Proposed Bonds shall become the property of the County, regardless of whether the Proposed District is formed and/or the Proposed Bonds are sold and issued; provided, however, that the Proponent shall be entitled to use the information contained in such documents.

Section 5. No Obligation to form a Community Facilities District; Abandonment of Proceedings.

(a) ~~The County expressly reserves the right to abandon~~ Recognizing the public purpose of this community-initiated Proposed District (as distinguished from a developer-initiated CFD), the Proponent and the County agree to work together to establish the Proposed District. The County agrees to consult with the Proponent prior to abandoning the proceedings for the establishment of the Proposed District and/or issuance of the Proposed Bonds for any reason at any time prior to the completion thereof. Without limiting the generality of the foregoing, the Proponent expressly acknowledges that the decision of the County to form a community facilities district and/or to issue special tax bonds under Chapter 32 is an exercise of the legislative authority of the Council of the County, and that the County may not enter into a contract or obligate the Council to exercise its legislative discretion in a particular manner. This Agreement does not, therefore, in any way create a contractual, legal or equitable obligation of or commitment by the County to approve the formation of the Proposed District or to sell the Proposed Bonds to finance the Project.

(b) Should the Proponent elect to abandon the proceedings, the Proponent shall provide written notification of such election to the County and request the County to terminate all consulting agreements and use reasonable efforts to minimize any and all additional County Costs.

(c) If proceedings to form the Proposed District and/or issue the Proposed Bonds are not completed and are abandoned for any reason at any time, there will be no obligation on the part of the County to reimburse the Proponent for any monies previously advanced pursuant to this Agreement. In such event, the County, however, agrees to return to the Proponent such portion of the remaining balance of the Deposit,

without interest, as the County determines to be in excess of the amount necessary to pay any outstanding County Costs which the County is obligated to pay, which determination shall be made as soon as reasonably practicable. If, for any reason, the remaining balance of the Deposit is not sufficient to pay all outstanding County Costs, the Proponent shall deposit such additional amounts as are required to pay all such County Costs.

(d) It is hereby expressly acknowledged and agreed that this Agreement is not a debt or liability of the County, and that the County shall not be obligated to advance any of its funds for purposes of forming the Proposed District or issuing the Proposed Bonds.

Section 6. Authority to Execute Agreement. The County and the Proponent each represents that it has the authority to execute, deliver and perform its obligations under the terms of this Agreement and that the individual(s) signing this Agreement on its behalf have full right and authority to bind said party to this Agreement.

Section 7. Designated Representatives; Notices. The following individuals are hereby designated as representatives for the County and the Proponent, respectively, to act as liaison between the parties:

County:

Director of Finance (or his/her designee)
County of Hawaii
25 Aupuni Street, Rm. 118
Hilo, Hawaii 96720

Proponent:

~~[Contact Person/Address]~~

[Puako for Reefs](#)
[69-1536 Puako Beach Drive](#)
[Kamuela, Hawaii 96743](#)

Any written notice, statement, demand, consent, approval, authorization, offer, designation, request or other communication to be given hereunder shall be given to the party entitled thereto at its address set forth above, or at such other address as such party may provide to the other party in writing from time to time. Each such notice, statement, demand, consent, approval, authorization, offer, designation, request or other communication hereunder shall be delivered to the party to whom it is addressed (a) if personally served or delivered, upon delivery, (b) if given by electronic communication, whether telex, telegram, electronic mail or telecopy upon sender's receipt of an appropriate answerback or other written acknowledgment, (c) if given by registered or certified mail, return receipt requested, deposited with the United States mail postage prepaid, 72 hours after such notice is deposited with the United States Mail, (d) if given by overnight courier, with courier charges prepaid, 24 hours after

delivery to said overnight courier, or (e) if given by any other means, upon delivery at the address specified in this Section.

Section 8. Jurisdiction and Venue. Each of the County and the Proponent (a) agrees that any suit action or other legal proceeding arising out of or relating to this Agreement shall be brought in state court in the County of Hawaii, (b) consents to the jurisdiction of each such court in any suit, action or proceeding, and (c) waives any objection that it may have to the laying of venue or any suit action or proceeding in any of such courts and any claim that any such suit, action or proceeding has been brought in an inconvenient forum.

Section 9. Amendments. This Agreement may be amended by an instrument in writing executed and delivered by the parties hereto.

Section 10. Waivers. No waiver of, or consent with respect to, any provision of this Agreement by a party hereto shall in any event be effective unless the same shall be in writing and signed by such party, and then such waiver or consent shall be effective only in the specific instance and for the specific purpose for which it was given.

Section 11. Indemnification. The Proponent hereby indemnifies, and agrees that it shall defend and hold harmless, the County and its officials, employees, contractors and agents, from and against any and all actions, claims, damages, losses or expenses of any kind whatsoever arising out of or relating to any acts or omissions on the part of the Proponent or any of its officers, employees, contractors or agents with respect to the Proposed District or the Proposed Bonds.

Section 12. Governing Law. This Agreement has been executed in and shall be governed by the laws of the State of Hawaii.

Section 13. Construction. The parties to this Agreement and their counsel have reviewed and revised this Agreement, and the normal rule of construction to the effect that any ambiguities in an agreement are to be resolved against the drafting party shall not be employed in the interpretation of this Agreement.

Section 14. Severability. If a provision of this Agreement is found to be void, illegal or unenforceable, then any such provision shall be deemed stricken and the remaining provisions hereof shall, nevertheless, remain in full force and effect.

Section 15. Entire Agreement. This Agreement shall constitute the entire Agreement between the parties. Any amounts to or clarification necessary to this Agreement shall be in writing and acknowledged by all parties to the Agreement.

Section 16. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall constitute an original, and all of which together shall be considered one and the same instrument.

IN WITNESS WHEREOF, the parties hereto have executed and delivered this Agreement as of the date and year first above written.

COUNTY OF HAWAI'I

By: _____
Name: _____
Title: _____

[PROPONENT]

County

PUAKO FOR REEFS, a Hawaii nonprofit corporation

By: _____
Name: _____
Title: _____

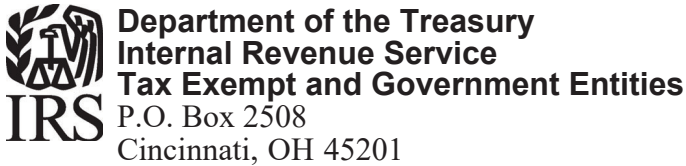
Proponent

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Table moves from	0
Embedded Graphics (Visio, ChemDraw, Images etc.)	0
Embedded Excel	0
Format changes	0
Total Changes:	70

✓	Step	Task	Notes	Exhibit #	Title
<input type="checkbox"/>	1.00	PHASE 1: FEASIBILITY & PLANNING			
<input checked="" type="checkbox"/>	1.10	Organize & Mobilize			
<input type="checkbox"/>	1.1.1	Is there an existing organization to represent the community (e.g., Homeowners or Community Association)? If yes, use this organization to spearhead the effort.	Puako did not have a mandatory membership Homeowners Association		
<input checked="" type="checkbox"/>	1.1.2	If not, determine whether to establish a new nonprofit corporation or to seek an existing 501(c)(3) to sponsor the community's organization.	Puako set up its own nonprofit 501(c)(3), Puako for Reefs (PFR)	1	IRS Tax-Exempt Letter
<input checked="" type="checkbox"/>	1.1.3	Form a steering committee of community members and recruited expertise.	PFR's officers were members of the community who had experience in managing nonprofits, financing, and government relations, and they recruited an experienced project manager volunteer.		
<input checked="" type="checkbox"/>	1.1.4	Identify the problem and objectives.	PFR consulted scientists and previous studies documenting the condition of Puako reef that determined the major cause of stress was the wastewater effluent, that even septic tanks and ATUs were a problem, and there was an urgency to remove the wastewater stress before the reef irreversibly declined.	2	Puako Reef scientific studies
<input checked="" type="checkbox"/>	1.1.5	Notify, educate, and survey the community.	PFR created a website (https://puako4reefs.org/), held several community forums, conducted a survey, and updated the community with newsletters.	3	Puako's initial community survey results and sample newsletter.
<input type="checkbox"/>	1.1.6	Consult with Councilmember on possibility of a County-initiated ID or CFD.	There is no clear existing procedure to request the County to initiate a process.	4	Proposed amendment to HCC Chapter 32 to clarify the County-initiated process and tap a revolving fund
<input type="checkbox"/>	1.20	Assess the situation and alternative solutions			
<input checked="" type="checkbox"/>		Consult with a special tax consultant and other experts to determine whether an ID or CFD is the appropriate means to finance the project.	Based on the consultation with the special tax consultant and legal counsel, PFR determined that a CFD was more appropriate than an ID due to the divergent property values within Puako.	5	Comparison of ID vs CFD.
<input checked="" type="checkbox"/>	1.2.1	Develop a workplan, budget, and funding strategy.	PFR raised funds through donations. An alternative is to request the County to initiate an ID or CFD.	6	Timeline
<input checked="" type="checkbox"/>	1.2.2	Create a map from a list with data from the Real Property Tax Office of the lots to be included.	PFR obtained a GIS list through the Planning Department.	7	Preliminary boundary map and TMK list.
<input checked="" type="checkbox"/>	1.2.3	Retain an engineer to prepare a preliminary engineering report that compares alternative solutions and costs.	PFR retained JPE.	8	Draft preliminary engineering report (PER).
<input type="checkbox"/>	1.2.4	If connecting to an existing private wastewater treatment plant, obtain a will-serve letter acknowledging the available capacity and setting forth the terms of commitment.	PFR's target date: Oct 2025		
<input type="checkbox"/>	1.2.5	If using a low-pressure sewer system with components on private property, determine the financing method, maintenance responsibilities, and estimated maintenance costs for the private property components	PFR's target date: Oct 2025		
<input type="checkbox"/>	1.30	Assess feasibility			
<input checked="" type="checkbox"/>	1.3.1	Estimate total development costs and average cost to homeowners.	PFR's special tax consultant prepared a rough proforma that identified the various cost variables.	9	Preliminary proforma
<input type="checkbox"/>	1.3.2	Determine alternative methods to set the assessment (for an ID) or special tax (for a CFD) rate.	PFR's target date: Sep 2025	10	Preliminary special tax roll (forthcoming)
<input type="checkbox"/>	1.3.3	Retain an environmental consultant to assess the permit requirements, environmental requirements (e.g., whether the project is exempt, EA, or EIS; whether federal NEPA triggered), and potential issues to develop a budget for the permits and environmental compliance.	PFR's target date: Sep 2025	11	Environmental and permit requirements memo (forthcoming)
<input type="checkbox"/>	1.3.4	Seek out funding sources to reduce the cost burden on the homeowners.	PFR is seeking funding from the State (for future State Parks connection), County (general water quality benefit to taxpayers), and resorts (enhanced visitor attraction).	12	Revised proforma (forthcoming)
<input type="checkbox"/>	1.3.5	With an estimated cost to homeowners, conduct a broad community outreach to determine if the required percentage of homeowners would support an ID or CFD.	PFR's target date: Q1 2026	13	Community outreach contract
<input type="checkbox"/>	1.3.6	Seek funding sources to pay for the design and construction phases. If USDA grant/loan, initiate application process.	PFR is considering the following options: USDA, CFD bond, private design-build	14	USDA meeting notes
<input type="checkbox"/>	1.40	Initiate the ID or CFD process			

✓	Step	Task	Notes	Exhibit #	Title
<input type="checkbox"/>	1.4.1	If County-initiated ID or CFD, tap the revolving fund to retain consultants to prepare the initial Resolution and supporting information.			
<input type="checkbox"/>	1.4.2	If community-initiated by petition with sufficient donations raised to fund the consultants needed to prepare the CFD Application and Resolution of Intent documentation, then sign the County's Deposit and Reimbursement Agreement and pay the \$75,000 deposit pursuant to the County's CFD Guidelines .	PFR is pursuing alternative CFD tracks: petition-initiated and, if the option becomes available, would switch to County-initiated.	15	Revised CFD Application (forthcoming)
<input type="checkbox"/>	1.4.3	Work with a Councilmember to introduce the initial ID or CFD Resolution.	PFR's target date: Q2 2026		
<input type="checkbox"/>	1.4.4	Work with DEM (for a sewer project) or DWS (for a water project) to prepare the Director's report, as directed by the initial Resolution.	PFR's target date: Q3 2026		
<input type="checkbox"/>	1.4.5	Prepare for the scheduled public hearing called for in the initial Resolution by reaching out to the community to educate and raise support.	PFR's target date: Q3 2026		
<input type="checkbox"/>	2.00	PHASE 2: DETAILED DESIGN			
<input type="checkbox"/>	2.10	Assuming that the ID or CFD is proceeding after the public hearing and funds have been identified to prepare the construction documents, give notice to the engineer to start preparing the construction documents (plans, specifications, and construction contract).	PFR's target date: Q4 2026		
<input type="checkbox"/>	2.20	Assuming DEM or DWS staff need assistance with review of the construction documents and construction inspection, retain a construction manager to work on behalf of the agency.	PFR's target date: Q4 2026		
<input type="checkbox"/>	2.30	Review the engineer's cost estimate at 80% completion of the design to determine whether the project is still feasible.	PFR's target date: Q3 2027		
<input type="checkbox"/>	2.40	Secure the construction financing. If the CFD or ID is funding the construction, then close the financing and reimburse the revolving fund or the community entity, as applicable. Otherwise, close the CFD or ID financing upon completion of construction for the amount that incorporates the completed construction cost to takeout the interim financing.	PFR's target date: Q4 2027		
<input type="checkbox"/>	2.50	Apply for the required permits.	PFR's target date: Q3 2027		
<input type="checkbox"/>	2.60	Bid and award the project.	PFR's target date: Q1 2028		
<input type="checkbox"/>	3.00	PHASE 3: CONSTRUCTION			
<input type="checkbox"/>	3.10	Execute the contract and issue notice to proceed.	PFR's target date: Q2 2028		
<input type="checkbox"/>	3.20	Inspect and manage the construction.	PFR's target date: Q2 2028 to Q2 2029		
<input type="checkbox"/>	3.30	Close the contract upon substantial and final completion, and release any retention.	PFR's target date: Q3 2029		
<input type="checkbox"/>	4.00	PHASE 4: OPERATIONS			
<input type="checkbox"/>	4.10	Connect to sewer system and close existing onsite system.	PFR's target date: Q4 2029		
<input type="checkbox"/>	4.20	Commencement payment of monthly operational fee.	For Puako, one of the threshold questions is how and how much to allocate the monthly fee between the County's collection maintenance costs and the PUC-approved fee for the private treatment costs.		

EXHIBIT 1



PUAKO FOR REEFS
C/O BARBARA BELL
69-1536 PUAKO BEACH DRIVE
KAMUELA, HI 96743

Date:
09/06/2023
Employer ID number:
93-2809206
Person to contact:
Name: Customer Service
ID number: 31954
Telephone: (877) 829-5500
Accounting period ending:
December 31
Public charity status:
170(b)(1)(A)(vi)
Form 990 / 990-EZ / 990-N required:
Yes
Effective date of exemption:
August 09, 2023
Contribution deductibility:
Yes
Addendum applies:
No
DLN:
26053636004203

Dear Applicant:

We're pleased to tell you we determined you're exempt from federal income tax under Internal Revenue Code (IRC) Section 501(c)(3). Donors can deduct contributions they make to you under IRC Section 170. You're also qualified to receive tax deductible bequests, devises, transfers or gifts under Section 2055, 2106, or 2522. This letter could help resolve questions on your exempt status. Please keep it for your records.

Organizations exempt under IRC Section 501(c)(3) are further classified as either public charities or private foundations. We determined you're a public charity under the IRC Section listed at the top of this letter.

If we indicated at the top of this letter that you're required to file Form 990/990-EZ/990-N, our records show you're required to file an annual information return (Form 990 or Form 990-EZ) or electronic notice (Form 990-N, the e-Postcard). If you don't file a required return or notice for three consecutive years, your exempt status will be automatically revoked.

If we indicated at the top of this letter that an addendum applies, the enclosed addendum is an integral part of this letter.

For important information about your responsibilities as a tax-exempt organization, go to www.irs.gov/charities. Enter "4221-PC" in the search bar to view Publication 4221-PC, Compliance Guide for 501(c)(3) Public Charities, which describes your recordkeeping, reporting, and disclosure requirements.

Sincerely,

Stephen A. Martin
Director, Exempt Organizations
Rulings and Agreements



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Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

A multi-indicator approach for identifying shoreline sewage pollution hotspots adjacent to coral reefs



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ARTICLE INFO

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Hawai'i
Macroalgae
Nutrients
Pollution score
Stable nitrogen isotopes

ABSTRACT

Sewage pollution is contributing to the global decline of coral reefs. Identifying locations where it is entering waters near reefs is therefore a management priority. Our study documented shoreline sewage pollution hotspots in a coastal community with a fringing coral reef (Puakō, Hawai'i) using dye tracer studies, sewage indicator measurements, and a pollution scoring tool. Sewage reached shoreline waters within 9 h to 3 d. Fecal indicator bacteria concentrations were high and variable, and $\delta^{15}\text{N}$ macroalgal values were indicative of sewage at many stations. Shoreline nutrient concentrations were two times higher than those in upland groundwater. Pollution hotspots were identified with a scoring tool using three sewage indicators. It confirmed known locations of sewage pollution from dye tracer studies. Our study highlights the need for a multi-indicator approach and scoring tool to identify sewage pollution hotspots. This approach will be useful for other coastal communities grappling with sewage pollution.

1. Introduction

With > 50% of the world's population living within coastal areas, sewage pollution has become a growing global problem that is largely unrecognized. Untreated sewage from cesspools and septic tanks is a concern for human and environmental health in rural areas (Lapointe et al., 1990; Paul et al., 2000; Whittier and El-Kadi, 2014). Sewage pollution is a complex environmental problem because it is a cocktail containing elevated and potentially hazardous levels of pathogens, hydrocarbons, nutrients, toxins, organic and inorganic compounds, and endocrine disruptors (Wear and Vega Thurber, 2015). For example, human exposure to sewage can result in skin and urinary tract infections, hepatitis, and gastroenteritis (Pinto, 1999). Annually, there are over 120 million gastroenteritis cases worldwide associated with sewage contaminated waters (Shuval, 2003). In addition, sewage pollution can have detrimental effects on coastal ecosystems (Wear and Vega Thurber, 2015). Coral reefs, which are one of the most economically valuable and biologically diverse ecosystems in the world, are steadily declining from multiple stressors including sewage pollution

(Wear and Vega Thurber, 2015). Sewage pollution has been linked with increased coral disease prevalence and severity (Sutherland et al., 2010; Redding et al., 2013; Yoshioka et al., 2016). White pox disease in Caribbean corals is one well documented example where a human pathogen is found in sewage, *Serratia marcescens*, was shown to cause the disease (Sutherland et al., 2010), although this relationship is disputed (Lesser and Jarett, 2014). Nutrient enrichments associated with sewage can stimulate benthic algal growth, resulting in a benthic phase shift from coral-to macroalgal-dominated reefs (Hunter and Evans, 1995; Lapointe et al., 2005). These nutrients also alter coral growth rates, species distribution and abundance, and coral community diversity (Pastorok and Bilyard, 1985; Parsons et al., 2008).

As the human population and associated coastal development continues to grow, monitoring water quality for sewage pollution is essential. Dye tracer studies provide irrefutable evidence that sewage from on-site sewage disposal systems (OSDS; i.e., cesspool, septic tanks) and treatment plants is entering and contaminating water bodies (Yates, 1985; HDOH, 1984; Glenn et al., 2013). These studies reveal hydrogeologic features connecting these treatment systems to

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nearshore waters, and are used to calculate pollution transit times, flow rates, and dilution within aquifers. However, dye tracer studies are laborious with hourly, daily, and in some instances, monthly sample collections. They also occur at one location at a time, and thus, provide limited geographical information on where sewage is entering into the ocean. Hence, they are only generally conducted when it is suspected that sewage is entering the ocean from a specific site.

In contrast, measurements of fecal indicator bacteria (FIB) are a more widely used to detect sewage than dye tracer studies, and they serve as a proxy for assessing human health risks (Cabelli, 1983; Prüss, 1998). *Enterococcus* spp. is monitored in marine recreational waters by the United States Environmental Protection Agency (USEPA) and state health agencies. In tropical locations like Hawai'i, a secondary indicator, *Clostridium perfringens*, is also assessed (Fujioka et al., 1997; Fujioka et al., 2015). Unlike *Enterococcus* spp., *C. perfringens* is an anaerobic, spore-forming bacterium that does not multiply in coastal waters, nor grows in tropical soils (Hardina and Fujioka, 1991; Fung et al., 2007). Hence, it is thought to more accurately detect sewage pollution than *Enterococcus* spp. (Fujioka and Shizumura, 1985; Hardina and Fujioka, 1991; Fujioka et al., 1997).

Measurements of stable nitrogen (N) isotopic composition ($\delta^{15}\text{N}$) in macroalgal tissues is another method employed to detect sewage pollution in coastal waters (Umezawa et al., 2002; Savage, 2005; Lin et al., 2007; Dailer et al., 2012; Wiegner et al., 2016). Macroalgae minimally discriminate between ^{14}N and ^{15}N . Therefore, they have similar isotopic compositions relative to their N sources (Savage, 2005). Sewage, in particular, has a very distinct stable N isotopic composition compared to other N sources, i.e., fertilizers, soils, groundwater, and ocean water (reviewed in Wiegner et al., 2016), and thus, has been successfully used to identify locations of shoreline sewage pollution (Umezawa et al., 2002; Savage, 2005; Lin et al., 2007; Dailer et al., 2010; Dailer et al., 2012).

Nutrient concentrations are also commonly used to assess water quality. It has been shown that nutrient concentrations are significantly higher nearshore with known sewage pollution (Lapointe et al., 1990; Nelson et al., 2015). However, measuring nutrients at the shoreline alone as a sewage indicator is not informative enough for management actions because of their numerous non-sewage watershed sources. Mixing plots of nutrient concentrations and salinity, a tool commonly used for examining mixing behavior and determining nutrient sources (freshwater vs. ocean) (Officer, 1979), may be useful for identifying locations where sewage is entering coastal waters and increasing nutrient concentrations.

Due to spatial and temporal variability associated with different sewage indicators, assessing pollution from a single one can be misleading. For example, authorities are more likely to post beach advisories when using *Enterococcus* spp. rather than *C. perfringens* (Shibata et al., 2004). In addition to FIB, $\delta^{15}\text{N}$ in macroalgal tissues can be highly variable due to N inputs from different sources with differing N isotopic compositions (Ochoa-Izaguirre and Soto-Jiménez, 2015). Hence, it is imperative to measure multiple sewage indicators to determine spatial and temporal pollution patterns particularly when concerned with both human and ecosystem health. However, few studies have done this to date, with most only measuring two indicators simultaneously because methods are difficult, expensive, and time consuming (Knee et al., 2008a; Baker et al., 2010; Moynihan et al., 2012; Yoshioka et al., 2016).

Hawai'i is an ideal location to develop a multiple sewage indicator approach as its coastal waters and coral reefs have been impacted by sewage pollution for decades (Pastorok and Bilyard, 1985; Whittier and El-Kadi, 2014). Presently, cesspools are the primary source of sewage pollution in rural areas, which comprise most of the state and are the location where the healthiest coral reefs are found. Hawai'i uses cesspools more widely than any other state (USEPA, 2013), and has only recently banned the installation of new ones (HDOH Administrative Rules-Title 11, HAR, 2016). Cesspools are particularly concerning in

Hawai'i where many of the homes are in close proximity to the water on highly porous substrate. As of 2014, there were over 110,000 OSDS in Hawai'i State. On Hawai'i Island alone, there are nearly 59,000 OSDS, with 49,000 being classified as cesspools (Whittier and El-Kadi, 2014). A high-risk area where OSDS are likely impacting nearshore waters on Hawai'i Island is Puakō (Whittier and El-Kadi, 2014). Puakō is a coastal community that is home to some of the richest, most diverse reefs in the state (Hayes et al., 1982). However, coral coverage has decreased from 80% in 1975 to 33% in 2010 (Minton et al., 2012), with concurrent decreases in fish abundance (49%–69%), and increases in turf and macroalgal cover (38%) (HDAR, 2013). Declining coral health and elevated disease prevalence and severity have also been documented (Couch et al., 2014; Yoshioka et al., 2016). While sewage pollution is thought to be one of the culprits contributing to these ecosystem changes, the link between these conditions and the presence of sewage has not been made.

The goal of this study was to develop a multiple sewage indicator approach to more accurately detect the presence of sewage in Puakō's nearshore waters. More specifically, we aimed to: 1) determine whether OSDS were hydrologically connected with coastal waters, 2) measure three sewage indicators including: FIB, $\delta^{15}\text{N}$ in macroalgal tissue, and nutrients along the shoreline, 3) identify locations of shoreline sewage pollution using mixing plots, and 4) pinpoint sewage pollution hotspots by developing a sewage pollution score.

2. Materials and methods

2.1. Site description

This study was conducted along the Puakō coastline in the South Kohala region of Hawai'i Island (Fig. 1), which is primarily comprised of basalt from the Mauna Loa Volcano. Annual rainfall ranges from 250 to 750 mm and infiltration of rainwater into the aquifer is high due to the permeable substratum. Average submarine groundwater discharge (SGD) at the shoreline ranges from 2083 to 2730 $\text{L m}^{-1} \text{h}^{-1}$ (Paytan et al., 2006).

Puakō is a residential community along a 3.5 km stretch of coastline with 207 lots, of which 163 have homes. The population is growing at a rate of 6.9% per year (Minton et al., 2012). At Puakō, 47 homes have cesspools and 139 have conventional septic tanks with leach fields (Schott, 2010). The entire coastline is accessible to the public and is frequently used for recreational activities such as fishing, surfing, SCUBA diving, and snorkeling. Presently, there is one development up-slope of Puakō, Waikoloa Village, which has 2000 homes, with 1587 having OSDS; the remainder are connected to the sewer line (per. comm. Hawai'i Water Supply).

2.2. Dye tracer studies

Dye tracer studies were conducted to determine the hydraulic connectivity between OSDS at four oceanfront homes. Studies were conducted along the southern portion of Puakō's coastline where nearshore waters are relatively fresh. Three homes had cesspools, and one had a fractured aerobic treatment unit (ATU) tank (a type of OSDS that utilizes an aeration process). Two of the four homes were occupied during the studies. At each home, the closest point where dye could be delivered to the OSDS was identified. Fluorescein, a non-toxic organic dye was used for the studies. It has a strong fluorescence and detection levels as low as 1 ppb (Gaspar, 1987; Reich et al., 2001). For our studies, 500–1000 g of high purity fluorescein dye (Amresco Fluorescein Sodium Salt) was injected over ~10 h. Each hour, 50 or 100 g of dye were mixed with 20 L of tap water and slowly added to the OSDS. Additional tap water was added throughout the day and its volume recorded to calculate an initial dye concentration.

To sample for the presence of dye at the shoreline, five to six stations were identified in front of each home and adjacent properties

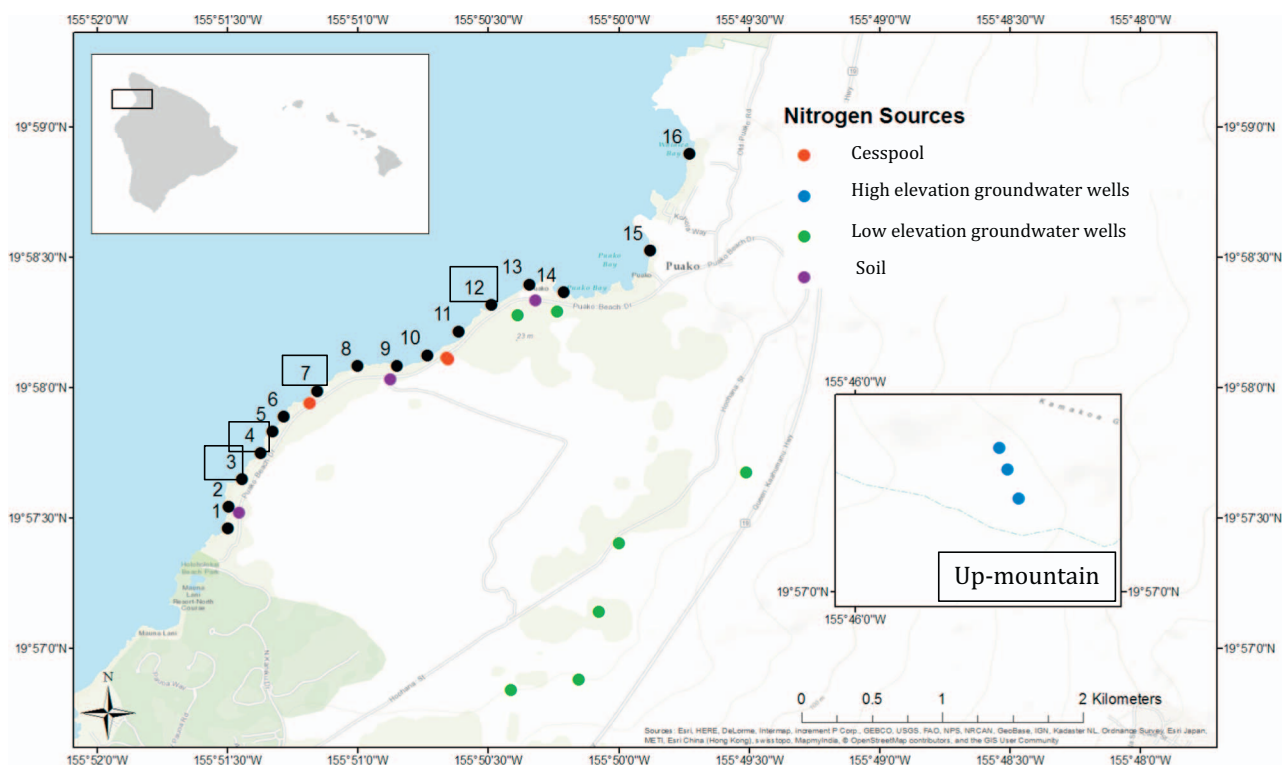


Fig. 1. Samples for fecal indicator bacteria (FIB), nutrients, $\delta^{15}\text{N}$ in macroalgae, and physiochemical parameters were taken from 16 stations along the Puako coastline, Hawai'i (black circles). Dye tracer studies were conducted in close proximity to the stations outlined with squares. Nitrogen sources sampled include cesspools, high and low elevation groundwater wells, and soil (colored circles). (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

(60–70 m of shoreline), representing three to four groundwater springs of varying salinity, and two stations with higher salinity and no apparent freshwater input. Water samples were collected at each station before and during dye tracer studies in opaque brown high density polyethylene bottles to prevent photodegradation, pre-rinsed with sample water, and stored at 4 °C until analysis. During the first 12 h of the dye study, samples were collected every 2 h to identify any fast-flow pathways. Afterwards, two samples were collected at each station within an hour of the lowest-low tide each day for up to 14 d.

To quantify the concentration of fluorescein, samples were brought to room temperature, filtered (Whatman™ GF/F), and analyzed using a Turner AU10 fluorometer in the dark. The detection limit for our analysis was 0.95 ppb (USEPA 40 CFR 2011). When salinity was not measured in the field, conductivity of samples was measured in the laboratory (Orion Star) and converted to PSS-78 salinity (UNESCO, 1981).

2.3. Shoreline station selection

To select shoreline stations for sewage pollution sampling, a salinity survey was conducted using a YSI 6600 V2 multi-parameter sonde interfaced with a Garmin etrex Global Positioning System. These shoreline stations were chosen prior to homes being identified for dye tracer studies. This was completed in the summer of 2014 during low tides to capture maximum SGD input. From this survey, 16 shoreline stations were chosen with varying salinity; four stations were coincidentally in front of properties where dye tracer tests were conducted (Fig. 1).

2.4. FIB and nutrient analyses

Triplicate water samples were collected in sterile, acid washed, polypropylene plastic bottles on four dates (November 2014, March, June, and July 2015) at each station and analyzed for FIB, nutrients, and salinity. Sample processing was conducted within 6 h of collection. Samples were taken during low tide when SGD is highest, and near

sunrise as sunlight reduces FIB survival (Fujioka et al., 1981). *Enterococcus* spp. was analyzed using the Enterolert MPN method (IDEXX Laboratories Inc.) following manufacturer's recommendations of 10 mL sample and 90 mL sterile water. The analytical range for this method is from 1 to 2419 MPN/100 mL. All *Enterococcus* spp. concentrations were corrected for sample dilution during analysis. When no wells fluoresced blue in the QuantiTray, *Enterococcus* spp. concentrations were reported as 5 MPN/100 mL, one-half the detection limit of the method after correcting for sample dilution. No diluted *Enterococcus* spp. concentrations exceeded the upper detection limit of the Enterolert MPN method. *C. perfringens* was enumerated by filtering 100 mL of sample water with 0.45- μm pore size cellulose nitrate filters (Whatman™) and mCP medium (Acumedia, Baltimore, MD, USA) (Bisson and Cabelli, 1979).

Water from one of the three samples was also filtered through a pre-combusted (500 °C for 6 h) filter (GF/F Whatman™), and stored frozen until analysis for nutrient concentrations at the University of Hawai'i at Hilo's (UH Hilo) Analytical Laboratory. Nutrients were analyzed on a Pulse Technicon™ II autoanalyzer using standard methods ($\text{NO}_3^- + \text{NO}_2^-$ [Detection Limit (DL) 0.07 $\mu\text{mol/L}$, USEPA 353.4], NH_4^+ [DL 0.36 $\mu\text{mol/L}$, USGS I-2525], PO_4^{3-} [DL 0.03 $\mu\text{mol/L}$, Technicon™ Industrial Method 155-71 W], total dissolved phosphorous (TDP) [DL 0.5 $\mu\text{mol/L}$, USGS I-4650-03], H_4SiO_4 [DL 1 $\mu\text{mol/L}$, USEPA 366]), and reference materials (NIST; HACH 307-49, 153-49, 14242-32, 194-49). Total dissolved nitrogen (TDN) was analyzed by high-temperature combustion, followed by chemiluminescent detection of nitric oxide (DL 5 $\mu\text{mol/L}$, ASTM D5176, Shimadzu TOC-V, TNM-1) (Sharp et al., 2002). Salinity was measured at the time of water collection using a YSI Pro 2030 multi-parameter probe.

2.5. $\delta^{15}\text{N}$ analyses

At the time of water sample collection, macroalgae with sufficient biomass to harvest were collected (~5 g) at all stations and analyzed for

$\delta^{15}\text{N}$ (Fig. 1). Multiple species were collected at each station because a common macroalgal species did not exist among them. The number of species collected varied with station. Macroalgal tissues were placed on ice during transport to the laboratory, where tissues were rinsed with deionized water. Subsamples of macroalgae were preserved as voucher specimens and identified to the lowest taxonomic resolution using an Olympus™ CH30 microscope (Abbott, 1999; Abbott and Huisman, 2004). The remaining algal tissues from each station were combined for a composite sample. These tissues were dried at 60 °C until a constant weight was achieved, ground and homogenized using a Wig-L-Bug grinding mill, and ~2 mg of the macroalgal tissue were folded in 4 × 6 mm tin capsules for stable isotope analysis. Macroalgal tissues were analyzed for $\delta^{15}\text{N}$ using a Thermo-Finnigan™ Delta V Advantage isotope ratio mass spectrometer (IRMS) with a ConFlo III interface and a Costech™ ECS 4010 Elemental Analyzer located at the UH Hilo's Analytical Laboratory. Data were normalized to United States Geological Service (USGS) standard NIST 1547. Isotopic signatures are expressed as standard (δ) values, in units of parts per mil (‰), and calculated as $[(R_{\text{sample}} - R_{\text{standard}}) / R_{\text{standard}}] \times 1000$, where $R = {}^{15}\text{N}/{}^{14}\text{N}$.

To determine the sources of N being used by the macroalgae, $\delta^{15}\text{N}$ - NO_3^- of potential sources were measured. Nutrient concentrations ($\text{NO}_3^- + \text{NO}_2^-$, NH_4^+ , and PO_4^{3-}) in these sources were also quantified. Sources sampled included: cesspools (n = 3), high elevation drinking water wells (n = 3), low elevation irrigation wells (n = 7), ambient seawater (n = 2), and soil (n = 3) from under Kiawe trees (*Prosopis pallida*). Kiawe is an introduced N_2 -fixing tree found widely on the leeward coast of Hawai'i Island, and contributes N to soil and groundwater (Dudley et al., 2014). Soil was collected directly under the Kiawe trees, dried, and then shaken overnight with reagent-grade water. N source water samples were collected at several locations to encompass spatial variability within Puakō's watershed. All N source samples were filtered through a 0.22- μm cellulose acetate filter (Whatman™) and frozen until analysis. $\delta^{15}\text{N}$ - NO_3^- samples were analyzed on a Thermo-Finnigan™ Delta Plus IRMS with data normalized to USGS standards (USGS32, USGS34, USGS53) at Northern Arizona University's Colorado Plateau Stable Isotope Laboratory. IAEA-NO3 was used as a check standard. Fertilizer values used in this study were from a previous study on Hawai'i Island (Wiegner et al., 2016). To determine their N sources, the $\delta^{15}\text{N}$ macroalgal tissue values were plotted relative to $\delta^{15}\text{N}$ source values (Derse et al., 2007; Wiegner et al., 2016).

2.6. Data analyses

To determine if FIB, nutrients, and $\delta^{15}\text{N}$ values in macroalgal tissue differed among stations, a one-way analysis of variance (ANOVA) was used for each variable. Correlations were used to evaluate associations between FIB, nutrients, $\delta^{15}\text{N}$ values, and other water quality parameters. Data were tested for normality and equal variances. If assumptions were not met for parametric analyses, log transformations were used. All statistical analyses were conducted using Minitab17 (2010) with $\alpha = 0.05$.

Nutrient concentration data on mixing plots were compared to a theoretical mixing line connecting the freshwater and ocean end members. When nutrient concentration data overlaid the mixing line, the nutrient was characterized as having conservative behavior, where only dilution with seawater is affecting the nutrient concentration in the nearshore waters. When data fell above or below the mixing line, the nutrient was described as behaving non-conservatively, with some source adding the nutrient to the water or some process removing it during mixing.

3. Results

3.1. Dye tracer studies

Dye was visually observed at the shoreline in front of all four homes. Of the three to four springs sampled during each test, dye only appeared

at one of the springs at the shoreline in front of the property with the OSDS being tested. The SGD at these springs dispersed over an area between 0.25 and 4 m^2 . Initial dye breakthrough at the shoreline, calculated from the difference in time from when the dye was added to the OSDS until its first appearance at the shoreline, ranged from 9 h to 3 d. Three of the homes had comparable flow rates between 4 and 14 m/d; the OSDS at one home was faster, where dye in SGD traveled 76 m/d. Based on dye dilution, the maximum fraction of sewage in the fresh-water at the shoreline varied from < 0.02 to 0.14%, depending on how much mixing occurred before discharge at the shoreline.

3.2. Sewage indicators

Contrasting patterns were seen among sewage indicators along shoreline stations. *Enterococcus* spp. concentrations ranged from 18 to 2777 MPN/100 mL, and significantly differed among stations ($p = 0.04$), with station 13 having the highest values, which were two times, to one or two orders of magnitude larger than other stations (Fig. 2, Table 1). *C. perfringens* concentrations ranged from 2 to 12 CFU/100 mL, and were similar among stations, averaging (mean \pm SE) 5 ± 3 CFU/100 mL across all stations ($p = 0.06$) (Fig. 2, Table 1). The most prevalent macroalgal species along the shoreline were *Ulva fasciata*, *Cladophora* spp., and *Gelidium acerosa*. The $\delta^{15}\text{N}$ in macroalgal tissue ranged from 4.23 to 11.88‰ across all stations, and significantly differed among stations ($p < 0.0001$) (Fig. 2, Table 1), with stations 3 and 4 having the highest values (Fig. 2). Six out of 16 stations fell

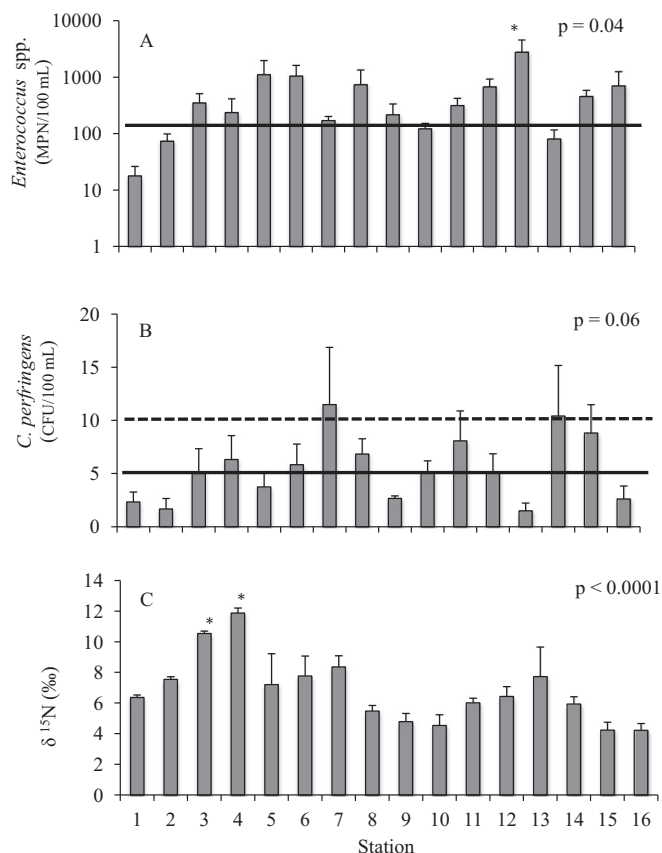


Fig. 2. Mean \pm SE of sewage indicators: (A) *Enterococcus* spp., (B) *Clostridium perfringens*, and (C) $\delta^{15}\text{N}$ (‰) of wild macroalgae at 16 shoreline stations at Puakō, Hawai'i. Hawai'i's Department of Health single sample maximum for *Enterococcus* spp. (104 CFU/100 mL, Fujioka et al., 1997) and a recommended marine recreational standard for *C. perfringens* (5 CFU/100 mL, Fung et al., 2007) are indicated by black lines. The dashed black line represents the lowest benchmark level for non-point sewage pollution for *C. perfringens* (10 CFU/100 mL, Fung et al., 2007). Results from One-way ANOVA and Tukey's tests are shown on the figure, with * indicating significant differences ($\alpha = 0.05$).

Table 1

Mean ± SE and [range] of *Enterococcus* spp., *Clostridium perfringens*, and δ¹⁵N in macroalgal tissues for shoreline stations at Puakō, Hawai'i. Superscript letters indicate significant groupings from One-way ANOVA and post-hoc Tukey's tests. α = 0.05; n = 4 samplings.

Station	<i>Enterococcus</i> spp. (MPN/100 mL)	<i>C. perfringens</i> (CFU/100 mL)	δ ¹⁵ N (‰)
1	18 ± 8 ^b [9–43]	2 ± 1 [0–4]	6.38 ± 0.15 ^{a-c} [6.03–6.65]
2	74 ± 25 ^{ab} [37–143]	2 ± 1 [0–4]	7.54 ± 0.18 ^{a-c} [7.04–7.90]
3	349 ± 162 ^{ab} [37–739]	5 ± 2 [1–10]	10.55 ± 0.15 ^{ab} [10.37–11.00]
4	237 ± 178 ^{ab} [47–770]	6 ± 2 [3–13]	11.88 ± 0.32 ^b [11.27–12.78]
5	1107 ± 861 ^{ab} [94–3674]	4 ± 1 [0–6]	7.21 ± 0.21 ^{a-c} [1.29–10.26]
6	1051 ± 570 ^{ab} [72–2546]	6 ± 2 [2–10]	7.77 ± 1.30 ^{a-c} [4.15–10.18]
7	170 ± 32 ^{ab} [104–257]	12 ± 5 [3–27]	8.35 ± 0.74 ^{a-c} [6.48–9.80]
8	738 ± 603 ^{ab} [62–2544]	7 ± 1 [3–10]	5.48 ± 0.37 ^{a-c} [5.06–6.58]
9	216 ± 120 ^{ab} [27–563]	3 ± 0 [2–3]	4.79 ± 0.53 ^{bc} [3.85–6.18]
10	122 ± 30 ^{ab} [66–202]	5 ± 1 [2–7]	4.54 ± 0.70 ^c [3.57–6.56]
11	315 ± 107 ^{ab} [15–495]	8 ± 3 [2–14]	6.02 ± 0.30 ^{a-c} [5.59–6.91]
12	676 ± 251 ^{ab} [121–1323]	5 ± 2 [2–8]	6.43 ± 0.65 ^{a-c} [4.90–8.04]
13	2777 ± 1806 ^a [17–7985]	2 ± 1 [0–3]	7.74 ± 1.92 ^{a-c} [4.80–13.12]
14	80 ± 36 ^{ab} [24–185]	10 ± 5 [1–20]	5.94 ± 0.47 ^{a-c} [5.08–7.28]
15	454 ± 132 ^{ab} [180–816]	9 ± 3 [2–13]	4.24 ± 0.51 ^c [3.62–5.77]
16	699 ± 554 ^{ab} [17–2338]	3 ± 1 [0–6]	4.23 ± 0.44 ^c [3.53–5.50]

within the sewage δ¹⁵N - NO₃⁻ range (9.62 to 11.57‰) (Table 2), including stations 3, 4, 5, 6, 7, and 13 (Fig. 3). The remaining stations fell within the high and low elevation groundwater ranges (Fig. 3). NO₃⁻ + NO₂⁻ concentrations were ~40 μmol/L lower in high elevation wells compared to the lower elevation ones (Table 2). In addition, PO₄³⁻ and NH₄⁺ concentrations were similar between high and low elevation wells (Table 2). NO₃⁻ + NO₂⁻, TDN, PO₄³⁻, TDP, and H₄SiO₄ concentrations significantly differed among shoreline stations (p < 0.001) (Table 3). Station 4 had the highest concentrations, and station 15 had the lowest concentrations for all nutrients, except H₄SiO₄. H₄SiO₄ concentrations were highest at station 14, which was ~500 μmol/L higher than the lowest measured concentration (Table 3). NH₄⁺ concentrations were similar across all stations (p > 0.06). Salinity also varied across stations (p < 0.01), with stations 2 and 14 being the freshest (Table 3). Nutrient concentrations (NO₃⁻ + NO₂⁻, TDN, PO₄³⁻, TDP, and H₄SiO₄) were also inversely correlated with salinity (p < 0.01). Mixing plot analysis revealed conservative mixing of groundwater-derived nutrients (NO₃⁻ + NO₂⁻, TDN, PO₄³⁻, TDP, and H₄SiO₄) with seawater, except for a few stations that consistently

Table 2

Mean ± SE of δ¹⁵N - NO₃⁻ (‰) and NO₃⁻ + NO₂⁻, PO₄³⁻, and NH₄⁺ concentrations (μmol/L) of N sources collected in the Puakō watershed, Hawai'i. (n = sample size).

N Source	n	δ ¹⁵ N-NO ₃ ⁻	NO ₃ ⁻ + NO ₂ ⁻	NH ₄ ⁺	PO ₄ ³⁻
Cesspools	3	10.45 ± 0.58	20.76 ± 10.50	6370.00 ± 806.16	378.58 ± 16.59
Soil	3	2.13 ± 2.37	6366.67 ± 3682.46	594.54 ± 93.23	193.56 ± 141.56
Ocean	2	3.02 ± 0.79	1.43 ± 0.08	2.52 ± 0.55	0.11 ± 0.05
High elevation groundwater wells	3	4.76 ± 0.43	93.87 ± 4.35	4.84 ± 1.43	2.48 ± 0.19
Low elevation groundwater wells	7	7.03 ± 0.50	130.09 ± 6.70	4.82 ± 1.19	2.48 ± 0.19
Shoreline	3	11.95 ± 1.13	133.93 ± 64.68	1.47 ± 0.44	5.27 ± 1.57

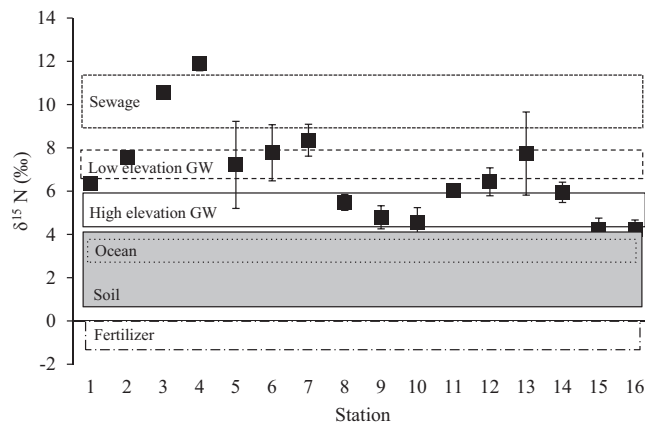


Fig. 3. Mean ± SE δ¹⁵N (‰) of wild macroalgae found at 16 stations in Puakō, Hawai'i. Background areas represent (mean ± SE) δ¹⁵NO₃⁻ of the N sources (fertilizer, soil, ocean, high elevation groundwater (GW) wells, low elevation GW wells, and sewage) measured as part of this study. Fertilizer values are from a previous study on Hawai'i Island (Wiegner et al., 2016).

fell well above the theoretical mixing line (Fig. 4). These included stations 3, 4, and 7. NH₄⁺ displayed non-conservative mixing (Fig. 4).

3.3. Associations between sewage indicators

Most sewage indicators were not correlated with each other. However, *C. perfringens* was positively correlated with NH₄⁺ (p = 0.02) (Fig. 5), and δ¹⁵N in macroalgal tissues was positively correlated with NO₃⁻ + NO₂⁻ (p < 0.001), TDN (p < 0.001), and PO₄³⁻ concentrations (p < 0.001) (Fig. 6).

4. Discussion

4.1. Sewage indicators

FIB are used by federal and state regulatory agencies to identify impaired recreational waters. At Puakō, *Enterococcus* spp. concentrations were highly variable across both space and time, with station 13 having the highest values. Additionally, when comparing our average values of *Enterococcus* spp. concentrations to Hawai'i Department of Health's (HDOH) single sample maximum of 104 CFU/100 mL, 13 out of 16 stations exceeded this threshold, with the majority of these stations exceeding it two to three of the four sampling times, and two stations exceeding it on all four occasions (Fig. 2). However, *Enterococcus* spp. concentrations have been shown to vary spatially, temporally, seasonally, and to be tidally influenced (Shibata et al., 2004; Maiga et al., 2009; Shibata et al., 2010; Nnane et al., 2011; Converse et al., 2012). In addition, *Enterococcus* spp. can persist in tropical soils and come from different animal sources (Hardina and Fujioka, 1991; Byappanahalli and Fujioka, 1998; Byappanahalli and Fujioka, 2004; Ragosta et al., 2010), and thus, may not be indicative of sewage. However, soils are an unlikely source of *Enterococcus* spp. at Puakō as the area generally lacks soil, the substratum is primarily

Table 3

Mean \pm SE and [range] of $\text{NO}_3^- + \text{NO}_2^-$, NH_4^+ , TDN, PO_4^{3-} , TDP, H_4SiO_4 concentrations ($\mu\text{mol/L}$), and salinity for shoreline stations at Puakō, Hawai'i. Superscript letters indicate significant groupings from One-way ANOVA and post-hoc Tukey's tests. $\alpha = 0.05$; $n = 4$ samplings.

Station	$\text{NO}_3^- + \text{NO}_2^-$	NH_4^+	TDN	PO_4^{3-}	TDP	H_4SiO_4	Salinity
1	27.87 \pm 4.09 ^{b-e} [18.10–36.79]	0.83 \pm 0.15 [0.78–1.23]	41 \pm 7 ^{c-f} [25–58]	0.44 \pm 0.04 ^{fg} [0.33–0.51]	0.7 \pm 0.1 ^{fg} [0.5–1.0]	133 \pm 23 ^{a-c} [87–195]	27.58 \pm 1.44 ^{a-c} [23.63–30.37]
2	149.94 \pm 12.79 ^{ab} [129.62–187.09]	0.49 \pm 0.11 [0.18–0.72]	159 \pm 13 ^{ab} [139–195]	2.24 \pm 0.24 ^{a-d} [1.62–2.73]	2.9 \pm 0.3 ^{a-e} [2.2–3.5]	581 \pm 155 ^{ab} [187–876]	7.12 \pm 0.61 ^e [5.77–8.70]
3	137.12 \pm 35.39 ^{a-c} [36.22–190.37]	1.95 \pm 0.30 [1.04–2.29]	154 \pm 39 ^{a-c} [41–217]	3.81 \pm 0.92 ^{ab} [1.34–5.37]	4.3 \pm 0.7 ^{ab} [2.4–5.1]	377 \pm 124 ^{a-c} [112–646]	16.26 \pm 3.96 ^{b-e} [9.50–25.73]
4	196.05 \pm 28.14 ^a [125.66–263.07]	1.30 \pm 0.05 [1.24–1.47]	221 \pm 26 ^a [153–267]	7.42 \pm 1.11 ^a [4.12–9.00]	8.3 \pm 1.4 ^a [4.5–10.8]	501 \pm 113 ^{ab} [172–683]	15.25 \pm 2.30 ^{c-e} [9.10–20.20]
5	46.92 \pm 8.73 ^{a-e} [23.44–65.52]	1.32 \pm 0.16 [0.86–1.57]	70 \pm 12 ^{a-f} [42–87]	1.34 \pm 0.17 ^{b-f} [0.90–1.71]	1.7 \pm 0.3 ^{b-f} [0.9–2.1]	179 \pm 41 ^{a-c} [85–278]	24.98 \pm 2.35 ^{a-d} [19.70–31.07]
6	26.78 \pm 11.48 ^{de} [2.50–54.16]	1.22 \pm 0.10 [1.03–1.46]	44 \pm 16 ^{d-f} [23–86]	0.66 \pm 0.21 ^{e-g} [0.25–1.17]	0.9 \pm 0.2 ^{fg} [0.3–1.3]	95 \pm 43 ^c [22–219]	30.77 \pm 2.31 ^a [24.53–35.53]
7	134.56 \pm 54.94 ^{a-d} [42.27–285.74]	1.69 \pm 0.65 [0.46–2.90]	131 \pm 43 ^{a-d} [53–241]	3.08 \pm 0.44 ^{a-c} [2.12–3.83]	3.4 \pm 0.5 ^{a-c} [2.2–4.5]	447 \pm 132 ^{ab} [164–804]	21.98 \pm 0.97 ^{a-d} [19.87–24.03]
8	39.15 \pm 14.53 ^{c-e} [0.99–67.10]	2.40 \pm 0.97 [1.00–0.33]	59 \pm 19 ^{b-f} [12–99]	0.70 \pm 0.23 ^{e-g} [0.52–1.07]	1.0 \pm 0.2 ^{e-g} [0.6–1.6]	253 \pm 83 ^{a-c} [31–416]	20.60 \pm 4.90 ^{a-d} [14.10–35.17]
9	69.74 \pm 9.06 ^{a-e} [47.81–91.92]	1.00 \pm 0.33 [0.89–1.77]	85 \pm 7 ^{a-e} [74–105]	1.37 \pm 0.13 ^{b-f} [1.15–1.73]	1.8 \pm 0.2 ^{b-f} [1.5–2.3]	342 \pm 90 ^{a-c} [219–609]	15.28 \pm 2.31 ^{cd} [8.53–18.53]
10	56.72 \pm 17.48 ^{a-e} [11.59–94.94]	0.95 \pm 0.27 [0.47–1.51]	73 \pm 19 ^{b-f} [20–106]	1.14 \pm 0.31 ^{e-g} [0.34–1.84]	1.5 \pm 0.2 ^{b-f} [1.2–1.8]	354 \pm 76 ^{a-c} [129–445]	15.03 \pm 3.60 ^{de} [4.90–21.90]
11	16.52 \pm 1.21 ^{de} [14.08–18.73]	0.96 \pm 0.30 [0.18–1.45]	29 \pm 4 ^{ef} [23–41]	0.49 \pm 0.04 ^{e-g} [0.40–0.58]	0.8 \pm 0.2 ^{fg} [0.3–1.3]	108 \pm 27 ^{bc} [53–173]	18.30 \pm 0.93 ^{ab} [26.07–30.60]
12	35.80 \pm 4.37 ^{a-e} [25.62–46.59]	1.34 \pm 0.25 [0.78–1.88]	46 \pm 5 ^{b-f} [34–56]	0.99 \pm 0.11 ^{e-g} [0.40–1.31]	1.3 \pm 0.3 ^{e-g} [0.9–2.1]	260 \pm 105 ^{a-c} [112–568]	24.50 \pm 0.96 ^{a-d} [22.57–27.13]
13	34.89 \pm 4.73 ^{a-e} [22.54–44.18]	1.21 \pm 0.19 [0.73–1.56]	49 \pm 7 ^{b-f} [35–67]	1.64 \pm 0.28 ^{b-e} [0.91–2.29]	1.9 \pm 0.2 ^{b-f} [1.7–2.4]	207 \pm 23 ^{a-c} [167–267]	23.96 \pm 2.00 ^{a-d} [19.90–28.27]
14	89.08 \pm 5.48 ^{a-d} [75.93–101.22]	1.15 \pm 0.29 [0.64–1.54]	101 \pm 7 ^{a-d} [84–117]	2.61 \pm 0.17 ^{a-c} [2.22–2.98]	2.9 \pm 0.3 ^{a-d} [2.4–3.6]	652 \pm 174 ^a [359–1018]	6.43 \pm 0.63 ^e [5.33–8.07]
15	13.37 \pm 2.80 ^e [5.73–19.24]	1.07 \pm 0.17 [0.75–1.44]	22 \pm 3 ^f [15–27]	0.39 \pm 0.09 ^g [0.16–0.55]	0.6 \pm 0.2 ^g [0.3–1.1]	120 \pm 24 ^{a-c} [52–158]	29.94 \pm 0.70 ^a [28.67–31.27]
16	38.50 \pm 7.20 ^{a-e} [17.35–47.44]	0.63 \pm 0.31 [0.18–1.51]	46 \pm 4 ^{c-f} [34–52]	0.81 \pm 0.13 ^{d-g} [0.45–1.09]	1.1 \pm 0.3 ^{d-g} [0.6–2.0]	323 \pm 86 ^{a-c} [142–552]	17.13 \pm 3.44 ^{b-e} [7.94–24.53]

basal, and shoreline concentrations were extremely high compared to state standards. While *C. perfringens* concentrations did not vary among stations, 11 of the 16 stations fell above the recommended standard to HDOH for marine recreational waters (5 CFU/100 mL) (Fujioka et al., 1997). Additionally, using the Fung/Fujioka *C. perfringens* scale for sewage pollution based on single sample maximums (Fung et al., 2007), only four of our stations (stations 7, 11, 14, and 15) were indicative of non-point sewage contamination (> 10 CFU/100 mL). The remaining five stations fell below this range, and were classified as not being polluted by sewage. While only certain stations had *C. perfringens* concentrations within the range for non-point sewage pollution, the correlation between *C. perfringens* and NH_4^+ suggest that sewage pollution may be more pervasive, as these two parameters are associated with anaerobic conditions, which are often found in OSDS.

While FIB are used to detect sewage, their application is primarily for assessing human health hazards for recreational water users. In comparison, $\delta^{15}\text{N}$ values in macroalgal tissues are used to determine N sources to coastal waters including sewage (Costanzo et al., 2005; Lapointe et al., 2005; Savage, 2005; Derse et al., 2007; Dailer et al., 2012). Typical sewage values range from +5 to +20‰ (reviewed in Wiegner et al., 2016), and values from cesspools in our study fell within this range (Table 3). $\delta^{15}\text{N}$ in macroalgal tissues along the Puakō shoreline ranged from 4.23 to 11.88‰, with six out of 16 shoreline stations falling within the range for sewage (Table 4). Stations 3 and 4 had the most enriched $\delta^{15}\text{N}$ macroalgal tissues, highlighting two potential sewage pollution hotspots. However, past studies have found that macroalgae assimilate N more rapidly under low NO_3^- concentrations (Fujita, 1985), and that $\delta^{15}\text{N}$ in macroalgal tissue can be underestimated by up to 6‰ in waters with high NO_3^- concentrations (> 10 $\mu\text{mol/L}$) (Swart et al., 2014). All of the stations had $\text{NO}_3^- + \text{NO}_2^-$ concentrations exceeding 10 $\mu\text{mol/L}$, suggesting that the $\delta^{15}\text{N}$ macroalgal values may be underestimated. If this was the case, then all 16 stations fall within the sewage range. In contrast, other

studies have found that tissue from opportunistic macroalgae reflects the nutrient concentrations in the water column (Fong et al., 1994). These macroalgae are often used as bioindicators as their tissues respond rapidly to N inputs (Duarte, 1995; Cohen and Fong, 2006). Two out of the three taxa (*U. fasciata*, *Cladophora* spp.) collected along the Puakō shoreline were opportunistic macroalgae. Opportunistic macroalgae taxa were not present at every station, possibly due to heavy grazing in the area. Hence, composite algal samples were analyzed, which included tissue from *G. acerosa*, a non-opportunistic species. Additionally, $\text{NO}_3^- + \text{NO}_2^-$, TDP, PO_4^{3-} , and TDN concentrations were nearly eight times greater at station 4 compared to all stations; this pattern was also seen with $\delta^{15}\text{N}$ in macroalgal tissues. These results further suggest that station 4 is a hotspot of non-point sewage pollution at Puakō. The significant positive correlation between $\delta^{15}\text{N}$ in macroalgae and nutrient concentrations further suggest that some portion of the nutrients' concentrations are derived from sewage (Fig. 6).

4.2. Hydrology

At Puakō, a large portion of the nutrient concentration data for $\text{NO}_3^- + \text{NO}_2^-$, TDN, PO_4^{3-} , and TDP fell on the theoretical mixing line, with highest concentrations at the lowest salinities. This result suggests that high elevational groundwater is a source of nutrients to Puakō's coastal waters and that they are behaving conservatively as groundwater and ocean water mix at the shoreline. This pattern, in part, explains the lack of associations between sewage indicators and salinity, as a large portion of groundwater nutrients discharging at the shoreline is from a nutrient source other than sewage. The conservative mixing nutrient patterns observed at Puakō have been documented elsewhere on Hawai'i Island in coastal areas with SGD (Knee et al., 2008b; Knee et al., 2010).

In contrast to the majority of our shoreline stations, data for stations 3, 4, and 7 consistently fell above the theoretical mixing line,

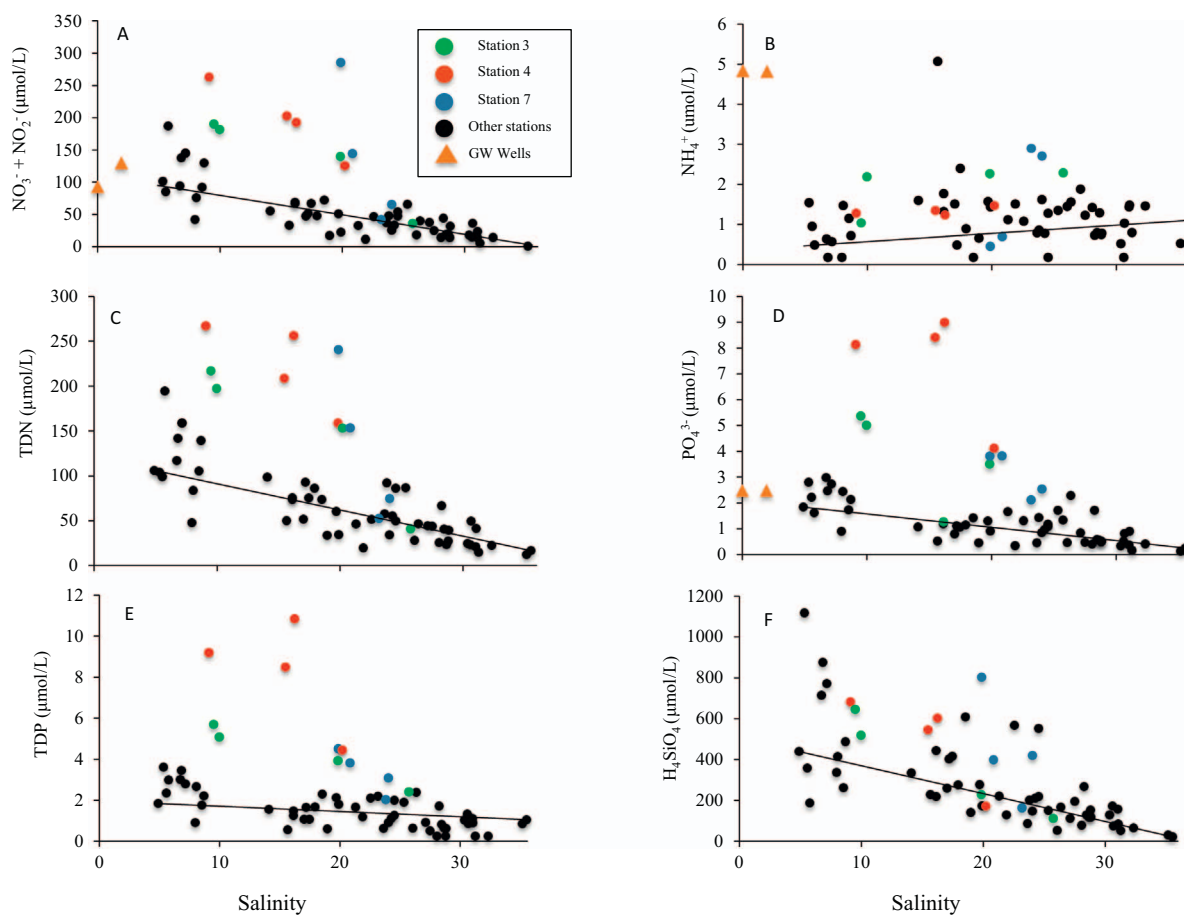


Fig. 4. Mixing plots of nutrient concentrations and salinity along the Puakō shoreline, Hawaii: (A) $\text{NO}_3^- + \text{NO}_2^-$, (B) NH_4^+ , (C) TDN, (D) PO_4^{3-} , (E) TDP, and (F) H_4SiO_4 . Line represents theoretical mixing line, connecting freshest and saltiest shoreline samples. Groundwater samples from wells were only analyzed for $\text{NO}_3^- + \text{NO}_2^-$, NH_4^+ , and PO_4^{3-} .

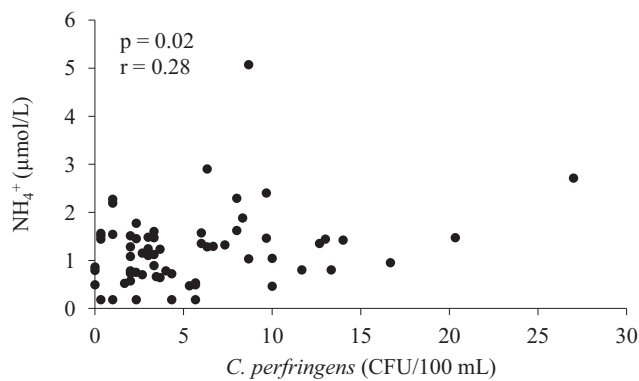


Fig. 5. Correlation between *Clostridium perfringens* and NH_4^+ along the Puakō shoreline, Hawaii.

suggesting there is a localized source of nutrients in those areas. The likely source is the OSDS as our dye tracer studies demonstrated that OSDS at these stations were leaking, and that the travel time from the homes to the shoreline was 9 h to 3 d. Additionally, dye was only observed seeping out during low tide and was localized within 10 m (longshore direction) of the shoreline. $\delta^{15}\text{N}\text{-NO}_3^-$ at these shoreline stations clearly fell within our measured $\delta^{15}\text{N}\text{-NO}_3^-$ sewage range at Puakō (Table 2), as did the $\delta^{15}\text{N}$ in the macroalgal tissue (Fig. 3). These results provide insight to the hydrology and geology at Puakō, where the fracture system within the basalt determines the flow path of the sewage from the OSDS to the shoreline, and affects the time of travel. Two other factors affecting sewage inputs are weather and house

occupancy. On the only rainy sampling day during this study (March 4, 2015), all three stations (3, 4, and 7) fell above the mixing line. This result illustrates that precipitation inputs may enhance the connection between the OSDS with the shoreline seeps through increased SGD. In contrast, there were some sampling dates on which nutrient concentrations for stations 3 and 7 fell on the mixing line. We suspect that on these dates, homes at these stations were not occupied, and therefore, their OSDS were not being used.

The $\delta^{15}\text{N}\text{-NO}_3^-$ and NO_3^- concentration data from the groundwater wells and shoreline stations also provided another insight into the hydrology of the Puakō watershed and coastal nutrient sources. The $\delta^{15}\text{N}\text{-NO}_3^-$ became increasingly enriched in ^{15}N moving downslope to the Puakō shoreline. The change in the $\delta^{15}\text{N}\text{-NO}_3^-$ from the high to low elevational groundwater wells suggests a change in NO_3^- source from forest soil to sewage. It is possible that sewage is contaminating the lower elevational groundwater as an upslope development (Waikoloa Village) has over 2000 homes with 1587 OSDS (per. Comm. Hawaii Water Supply). Additionally, NO_3^- concentrations increased ~ 40 mmol/L from the high to low elevational groundwater wells (Table 3). Lastly, the $\delta^{15}\text{N}$ enrichment in the $\delta^{15}\text{N}\text{-NO}_3^-$ from the lower elevational groundwater wells to the shoreline seeps suggests that additional sewage from Puakō homes is contaminating the groundwater before it is discharged along the shoreline. To understand the relative percent contributions of these two different communities to sewage pollution along Puakō's shoreline, more $\delta^{15}\text{N}\text{-NO}_3^-$ and $\delta^{18}\text{O}\text{-NO}_3^-$ data, as well as a mixing model capable of determining source contributions are needed (Wiegner et al., 2016). With this additional information, informed decisions about management actions can be made.

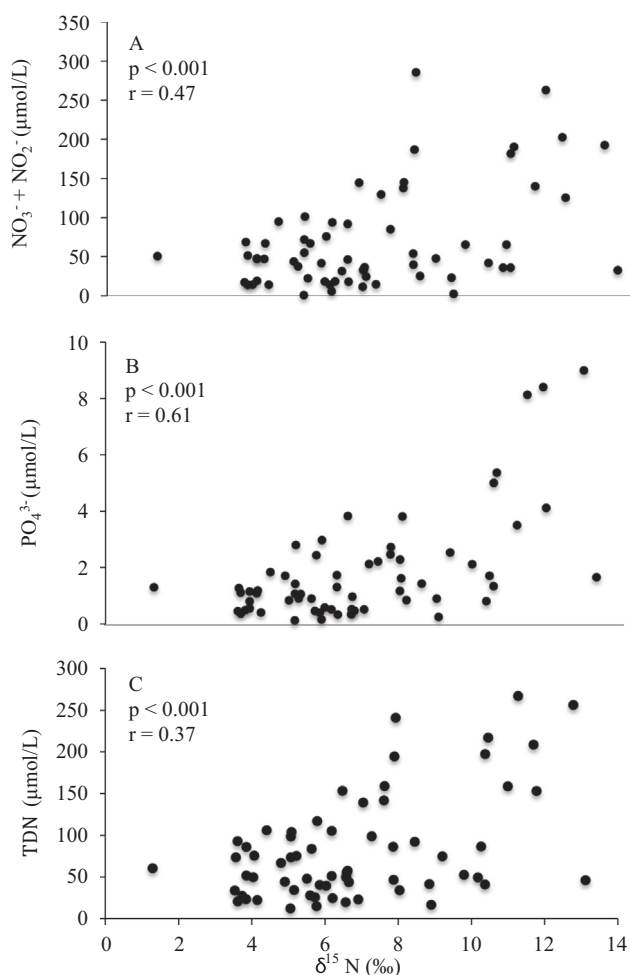


Fig. 6. Correlations between $\delta^{15}\text{N}$ in macroalgal tissues and nutrient concentrations: (A) $\text{NO}_3^- + \text{NO}_2^-$, (B) PO_4^{3-} , and (C) TDN along the Puakō shoreline, Hawai'i.

4.3. Development of a sewage pollution score

As this study and others have shown, sewage indicators can provide conflicting information on the intensity and location of sewage pollution along the shoreline. Previous studies have confronted similar issues with their sewage indicator data (Shibata et al., 2004; Yoshioka et al., 2016). Hence, creating a sewage pollution score using several sewage indicators may be a more holistic way to assess sewage pollution in coastal waters. Water quality scores and indices have been used successfully in the past to assess healthy water quality conditions for both humans and ecosystems (Zambrano et al., 2009; Wang et al., 2015). Interpolative mapping of water quality score or index values provides a simple and clear tool for managers and policymakers that allow them to relate human activities to water quality and identify areas in need of better management (Zambrano et al., 2009).

Table 4

Sewage indicators (fecal indicator bacteria = CFU/100 mL, $\delta^{15}\text{N}$ = ‰, and nutrients = $\mu\text{mol/L}$) used to evaluate water quality along the Puakō coastline, Hawai'i. These indicators were ranked (low = 1, medium = 2, and high = 3), multiplied by a weight factor, and summed for a final sewage pollution score. "Medium" nutrient concentration scores exceed HDOH standards (see Discussion for details).

Sewage indicator	Weight factor	Low (1)	Medium (2)*	High (3)	Reference
<i>Enterococcus</i> spp.	2	0–35	36–104	105+	HDOH, 2014
<i>Clostridium perfringens</i>	3	0–10	11–100	101–505+	Fung et al., 2007
$\delta^{15}\text{N}$ in macroalgae	3	0.00–5.99	6.00–10.99	11.00+	Current study
$\text{NO}_3^- + \text{NO}_2^-$	1	0.0–0.4	0.5–1.0	1.1–1.8+	HDOH, 2014
NH_4^+	1	0.00–0.25	0.26–0.61	0.62–1.07+	HDOH, 2014
TDP	1	0.0–0.7	0.8–1.3	1.4–1.9+	HDOH, 2014

To better assess sewage pollution conditions along the Puakō shoreline, a scoring tool was developed using three sewage indicators (FIB, $\delta^{15}\text{N}$ macroalgae, and nutrients). The scoring tool had three levels for each indicator: level 1 = low, level 2 = medium, and level 3 = high. Levels for each indicator were based on established standards, literature information, or data from this study (Table 4). Specifically, the scoring tool used HDOH's geometric mean and the single sample maximum for *Enterococcus* spp. concentrations in marine waters, the Fung/Fujioka *C. perfringens* scale for sewage pollution, $\delta^{15}\text{N}$ values in macroalgal tissues for different NO_3^- sources (Table 2), and HDOH's water quality standards for nutrient concentrations in open coastal waters ($\text{NO}_3^- + \text{NO}_2^-$, NH_4^+ , and TDP) (Table 4). Nutrient concentration standards for the wet criteria were used because the freshwater discharge along the Puakō shoreline ranged from 2083 to 2730 $\text{L m}^{-1} \text{h}^{-1}$ (Paytan et al., 2006), which are an order of magnitude larger than the baseline for the wet criteria ($> 294 \text{L m}^{-1} \text{h}^{-1}$). Two dissolved inorganic forms of N were chosen for the score tool rather than TDN because it contains DON, and sewage-derived DON's contribution to eutrophication is only beginning to be investigated (Pehlivanoglu and Sedlak, 2004; Urgun-Demirtas et al., 2008; Bronk et al., 2010; Filippino et al., 2011). TDP was used as the phosphorous water quality indicator since HDOH has no PO_4^{3-} water quality standard for open coastal waters (HDOH, 2014). It should also be noted that a medium level in nutrient concentrations exceeds HDOH standards for open coastal waters' wet criteria.

Once each indicator was assigned a level (1–3) based on its measured value and our scoring tool (Table 4), its level was multiplied by a weight factor (1–3), with the most reliable sewage indicators having the greatest weight. The greatest weight (weight = 3) was given to *C. perfringens* and $\delta^{15}\text{N}$ in macroalgal tissue because these indicators are more specific to sewage pollution, more integrative measurements of environmental conditions, and do not fluctuate as much as *Enterococcus* spp. and nutrient concentrations (Fung et al., 2007; Dailer et al., 2010; Viau et al., 2011; Yoshioka et al., 2016). *Enterococcus* spp. concentrations received a medium weight (weight = 2) as HDOH uses this FIB to assess marine recreational water safety specifically for sewage pollution, but not the highest weight because concentrations fluctuate over short time scales (min to h) and have other sources, like soils, in tropical areas (Hardina and Fujioka, 1991; Byappanahalli and Fujioka, 1998; Byappanahalli and Fujioka, 2004). Nutrient concentrations received the lowest weight (weight = 1) since sewage pollution is known to increase them, but nutrients can also come from other sources within the watershed and concentrations can vary over short time scales (Lapointe et al., 1990; David et al., 2013; Nelson et al., 2015). The equation for calculating the overall sewage pollution score for each station was: (*C. perfringens* level \times 3) + ($\delta^{15}\text{N}$ macroalgae level \times 3) + (*Enterococcus* spp. level \times 2) + ($\text{NO}_3^- + \text{NO}_2^-$ level \times 1) + (NH_4^+ level \times 1) + (TDP level \times 1). Sewage pollution score categories were: low = 11–17, medium = 18–25, and high = 26–33. The high end of the range for the low and medium sewage pollution score categories were calculated as the sum of low or medium scores for all indicators, respectively, except for nutrient concentrations, which were allowed to fluctuate up to the high level as inputs from non-sewage sources can result in high concentrations.

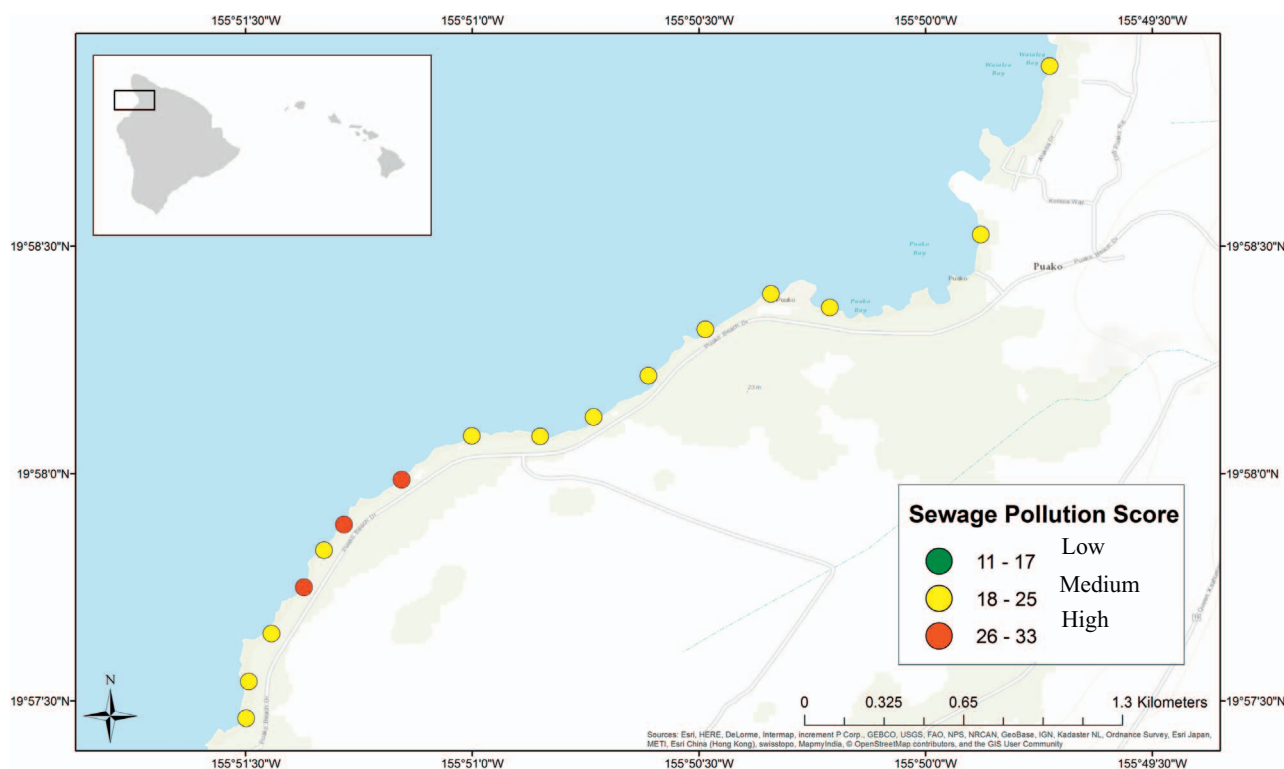


Fig. 7. Sewage pollution scores for 16 stations along the Puakō shoreline, Hawai'i, were based on established and recommended water quality standards, literature values for sewage indicators, and measured values from this study (fecal indicator bacteria, $\delta^{15}\text{N}$ in macroalgae, and nutrients). Sewage pollution score categories are: low = 11–17; medium = 18–25; high = 26–33. Details on the calculation of the sewage pollution score are provided in the Discussion section.

The stations with highest pollution sewage scores were stations 4 (score = 30), 6 (score = 26), and 7 (score = 27) (Fig. 7). Note, stations 4 and 7 are known locations of OSDS leakage from the dye tracer studies. These results confirm the effectiveness of our sewage pollution score in identifying hotspots of sewage pollution. Overall, three stations fell in the high category with the remainder in the medium category. This integrated approach identified sewage hotspots along the Puakō coastline, and locations where it is critical for homes to remove their cesspools and employ better sewage treatment technology. This map also provides information to the community on areas where residents and visitors may want to limit water exposure during recreational activities until sewage treatment is improved.

5. Conclusion

Globally, coral reefs are declining from multiple stressors, with sewage pollution being one of the most devastating (Wear and Vega Thurber, 2015). Dye tracer studies confirmed locations of sewage pollution and provided information on the time of travel from homes to the shoreline. FIB and nutrient concentrations were high and variable along the Puakō shoreline, and $\delta^{15}\text{N}$ in macroalgal tissue were within the sewage range. However, data from different indicators were not always in agreement with one another on the intensity and locations of sewage pollution. Hence, a novel pollution score was developed using these indicators to identify sewage hotspots. With sewage becoming a growing global threat in nearshore waters, being able to effectively assess its pollution is crucial for both human and marine ecosystem health. A multi-indicator approach for detecting sewage and this pollution scoring tool will allow other coastal communities to assess their water quality and take appropriate management actions, improving safety of recreational waters users and coastal ecosystem health.

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**PUAKŌ FOR
REEFS**

EXHIBIT 3

A Community Dedicated to Saving Puakō Reef

Return the reef to its historic 75% coral coverage from its existing 7%.

Sewer System in Puako Update – September 2023

Purpose of the Puako for Reefs Committee

- Can a sewer system be built in Puako that is affordable to residents?
- What is the solution that will work?

Past year of work

The committee has been working hard to answer these two questions. It has often been very frustrating, and we have found ourselves being spun in circles. However, recently, we believe we are on a path that has some traction, the support of many of the required players, and possible funding sources identified to support the work required to issue an RFP for the construction of a system. The path is still long and complicated, but we have growing confidence that we might just prevail.

List of people with whom we have spoken multiple times.

- Government: Mayor Mitch Roth and his staff, County Council woman Cindy Evans, Director of Waste Management Ramzi Manzoor, Director of Public Works Steve Pause.
- Wastewater Companies: American Waters at Mauna Lani, Hawaii Waters in Waikoloa, Bill Campbell retired wastewater executive,
- Engineering: Corollo Engineers, Brown and Caldwell Engineering
- Non-profit organizations: CORAL, RCAC, Hawaii Community Foundation,
- National Finance Centers: ...(list from Monday meeting at church),

Lessons learned.

Solution 1: American Waters at Mauna Lani solution

- The County wants Puako to connect to American Waters (AW) at Mauna Lani (ML)
 - It cannot afford to run lots of small package plants across the island. They prefer using systems that exist.
- AW has the capacity and interest to take Puako waste.
 - It will upgrade its system when the state mandates it.

Hurdles

- County must own and run collection system.
 - It is economically unfeasible for AW to own our collection system since they don't have a mechanism to compel homeowners to connect nor pay for collection since we are not an HOA.
 - A county ordinance compels payment for use of a sewer that passes near a home.
- Puako community must build, and finance collection system then dedicate it to the county to operate.
 - State law prevents a county-built collection system from sending the waste to private facilities.
 - It will also be more expensive and time-consuming for the county to build.
- Permissions required.
 - Public Utilities Commission (PUC) must expand AW's Service District and define a fare rate for Puako.
 - Permits will be needed from the county, state, and ML to situate the collection system on their lands.
 - Environmental and cultural impact studies completed and resolved.
- Financing established.



**PUAKŌ FOR
REEFS**

A Community Dedicated to Saving Puakō Reef

Return the reef to its historic 75% coral coverage from its existing 7%.

- Current estimates are that the collection system and connection to the Mauna Lani will cost \$11.5M.
- The committee is researching several financing mechanisms including establishing a new Community Finance District which will allow bonds to be issued.
 - Community Support
 - The County Council will require 70% of the community to support the proposed sewer solution to be able to recommend it.
 - Construction
 - Write and issue an RFP to build the system and choose the contractor to implement the plan.

Solution 2: Puako's own package wastewater plant

- The 2023 flooding made the placement of package plant difficult in the flood plains surrounding Puako.
 - While this solution is still a possibility, the flooding needs to be investigated first.
- County has raised \$250K to study the storm water flooding above Puako

Next Steps

Secure funding

All the work items listed above require expertise and operating capital to resolve. The committee has taken the following steps.

1. Created a new non-profit organization, Puako for Reefs, Inc. (www.puako4reefs.org) to be able to apply for grants and receive philanthropic donations.
2. Awarded \$250K: Worked with Hawaii Department of Health and Corollo Engineers to receive funding from an EPA grant. This grant will be administered by Corollo and will do the following.
 - Produce an official Basis of Design Report (BODR) (capital, O&M, life cycle costs) for both solutions and a recommendation for one.
 - a. Connection to the Mauna Lani and package plant in Puako.
 - This will be used to secure initial commitment from the required partners and the community.
3. Applied for \$1.4M: The new non-profit, Puako4reefs, wrote a Letter of Intent (LOI) for a NOAA grant, *NOAA Climate Resilience Regional Challenge (2023)* to cover most of the work items listed above and other items required for NOAA compliance with climate change resilience for a coastal community. The main points of the LOI are listed below. We will find out from NOAA if we are invited to send in a full application in October. The grant will be awarded in February, and the money will be distributed in October of 2024. LOI available upon request.
4. \$300K required: If we receive the \$1.4M NOAA grant, we will need to raise \$300K in philanthropic donations to match it. The committee is already beginning to research possible grants and donations from foundations and will also need to depend on the generosity of the community.

Community Outreach



**PUAKŌ FOR
REEFS**

A Community Dedicated to Saving Puakō Reef

Return the reef to its historic 75% coral coverage from its existing 7%.

Led by Science

In 2018 a study evaluating management strategies to optimize coral reef ecosystem services was conducted on Puako reef by Hawaii's Department of Aquatic Resources (DAR), in conjunction with NOAA and The Nature Conservancy. The purpose of the study was to understand how to better manage natural resources for the long-term viability of the reef and the coastal community in the face of climate change. The Hawaii Tribune-Herald reported:

"The study came to one conclusion: the management scenario now employed in Hawaii's near shore waters is not only insufficient to replenish the state's marine ecosystems already in peril, but also insufficient to curb current declines.... (According to NOAA Scientist Mariska Weijerman) **'Results suggest that a combination of reducing land-based pollution and allowing only line fishing seems to be generating the most balanced tradeoffs between stakeholders...'**

July 2023 study by Arizona State University, NOAA's Pacific Islands Fisheries Science Center and Bangor University, (published in Nature magazine) emphasized the importance of addressing land-based threats to the reef's health before attempting restoration. An ASU News article reported:

"There is a very strong perception that declining reef health is mainly driven by climate change, which is true in the long term," said Greg Asner, senior author of the study and director of ASU's Center for Global Discovery and Conservation Science, a unit of the Julie Ann Wrigley Global Futures Laboratory **"However, what we are putting in our waters from our shores, as well as the amount of fishing we are doing, are huge drivers that are more immediately actionable."**

Puako Sewer Survey Result summary – 5/2024

- 88 respondents
 - 15% cesspool (total in community is about 50%)
 - 38% septic system
 - 38% aerobic treatment unity
- 96.5% would connect to the sewer system if affordable.
- Do not know enough to decide if it should go to Am. Waters or a new treatment system in Puako.
- Biggest concerns
 - 81% upfront costs
 - 80% usage costs
 - Assist homes that can't afford hookup
 - Getting 100% connections
 - * Slow pace to get it done.
 - * Accurate short and long-term costs
 - * Will it really save the reef?
 - * Money to get it done.

88 responses

 [View in Sheets](#)



Accepting responses

Summary

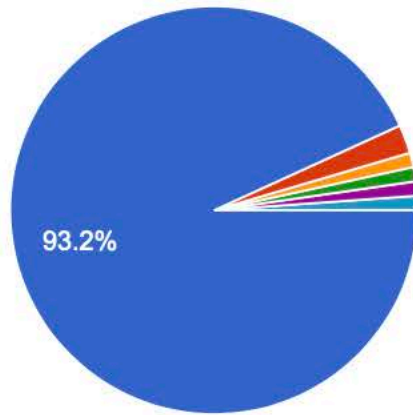
Question

Individual

Is your home in the Puakō Community?

 Copy

88 responses

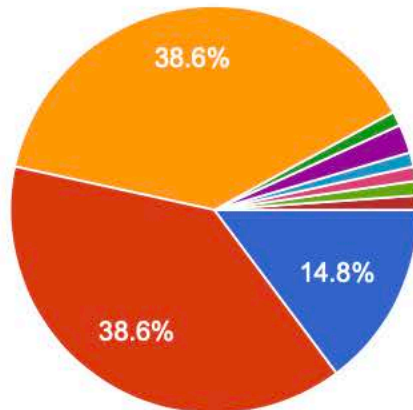


- Yes
- No
- I oa condo there, live elsewhere
- Nearby community, same reef
- Rental condo yes
- Property manager for 2 lots

What type of onsite disposal system do you have?

 Copy

88 responses

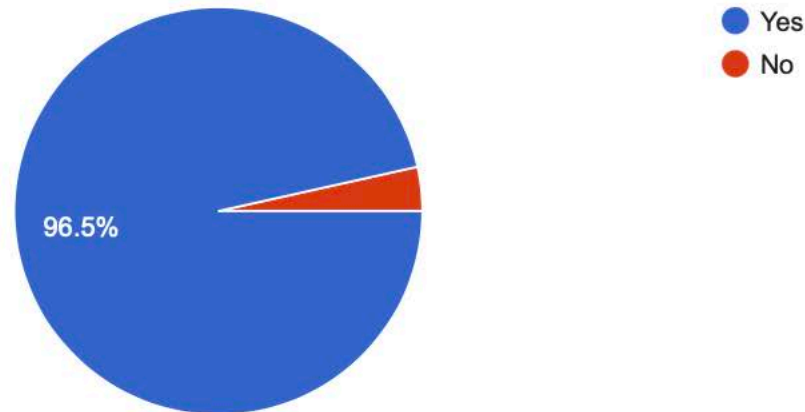


- Cesspool
- Septic Tank
- Aerobic Treatment Unit
- My property is connected to the sewer
- I don't know
- 2 properties. one with Cesspool the other with septic tank
- Puako condos septic treatment
- I believe we have a multi-tiered septic...
- One cesspool and one aerobic treatme...

If affordable, would you switch your current waste water system to a sewer system in Puakō to protect the reef and reverse its decline?



86 responses



Wastewater Collection: If a collection system is installed to receive wastewater from homes, community efforts may be needed to secure financial support from government agencies. This could include community members forming a Community Facilities District (CFD) and paying a fee to help fund the system.



How do you feel about forming a CFD and paying a fee for the collection system?

87 responses

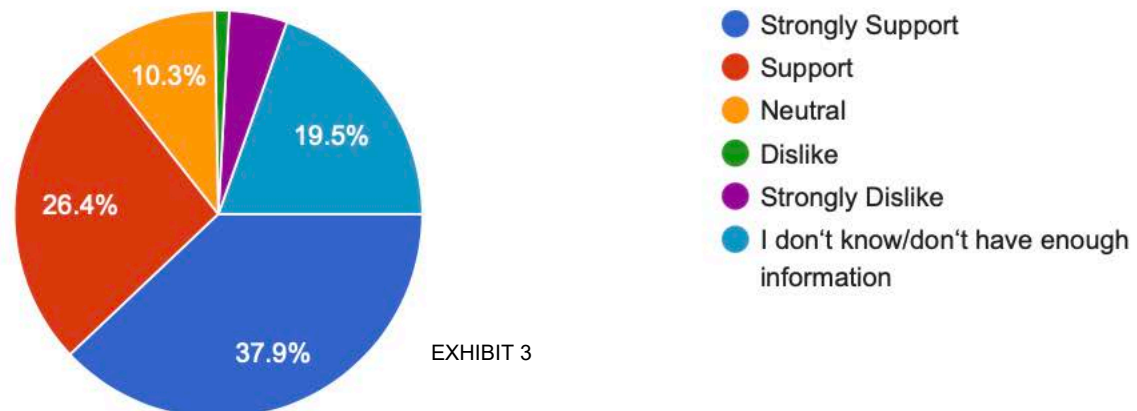


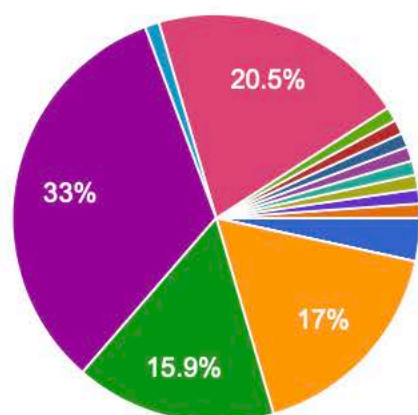
EXHIBIT 3

Wastewater Treatment: Based on previous studies, the community has been considering two main options (see list below):

- 1) Treat wastewater at a new decentralized package plant near Puakō.
- 2) Transport wastewater via a new transmission line to the existing American Waters Wastewater Treatment Plant (WWTP).

Which treatment option would you prefer for the Puakō community?

88 responses

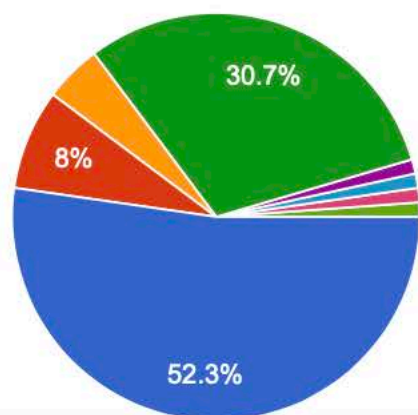


- Strongly prefer treating wastewater at...
- Somewhat prefer treating wastewater a...
- Neutral about either treatment option.
- Somewhat prefer transporting wastewa...
- Strongly prefer transporting wastewate...
- Neither option is preferred.
- I don't know/don't have enough inform...
- Any option that improves effluent

▲ 1/2 ▼

Which location would you prefer for the new decentralized plant?

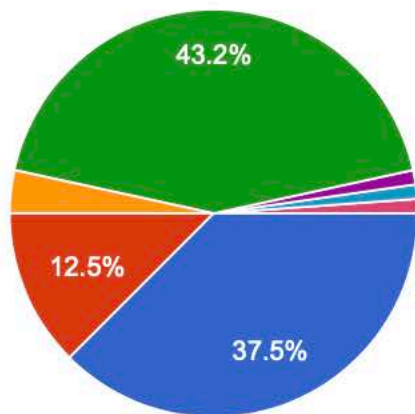
88 responses



- Southwest of the solid waste transfer station (Location #1)
- Behind the Ascension Mission Church (Location #2)
- None of these locations is preferred
- I don't know/don't have enough inform...
- Either location is fine
- See Above has their been an analysis...
- Neither. I think the solution is to use an...
- I don't know/don't have enough inform...

Which route would you prefer for sending flows to the Mauna Lani WWTP?

88 responses

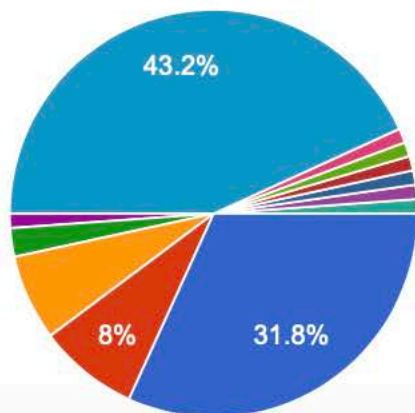


- Route A
- Route B
- Neither is preferred
- I don't know/don't have enough information
- I can't see enough detail to understand what the differences are.
- Any route just get er done!
- Most cost effective route

Treated Wastewater Disposal: There are different options for reuse/disposal of the treated wastewater. Note that per the Hawai'i Department of Health Reuse guidelines, a backup disposal system is required to prevent overflows or discharges from the system when the recycled water is not being used, when the volume of recycled water exceeds demand and requires disposal, or other reasons. Backup disposal systems could include an injection well, leach field, or other options.

Which disposal option(s) would you prefer for the Puakō community? Select one or more.

88 responses



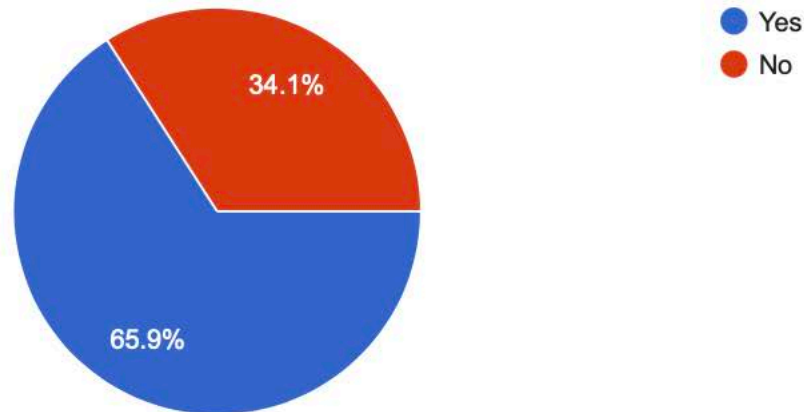
- Water reuse for firebreaks and backup...
- Water reuse for agriculture and backup...
- Water reuse for commerical or industri...
- Water disposal into an injection well
- Water disposal into a leachfield
- I don't know/don't have enough inform...
- I support the first three options
- None

Part II: Survey Questions for Puako for Reefs Committee

Do you feel you have enough current and accurate information about the quality of Puakō's water and the conditions of the reef?



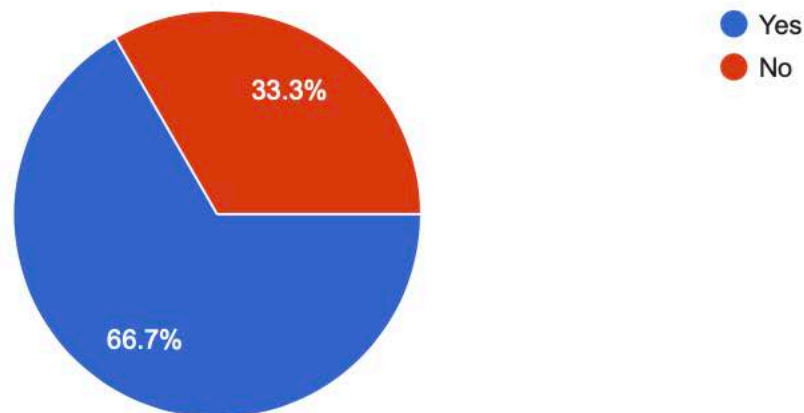
88 responses



Do you feel that you have enough current and accurate information about effectiveness of septic tanks, aerobic treatment units or other systems in protecting our reef?



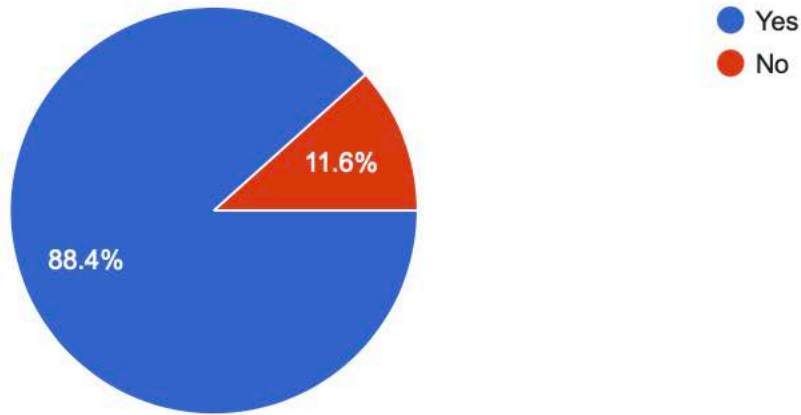
87 responses



Will you attend PFR community meetings to learn more?

 Copy

86 responses



Do you want to get more involved with the PFR committee to help the community reverse the Puako coral reef decline?

 Copy

80 responses

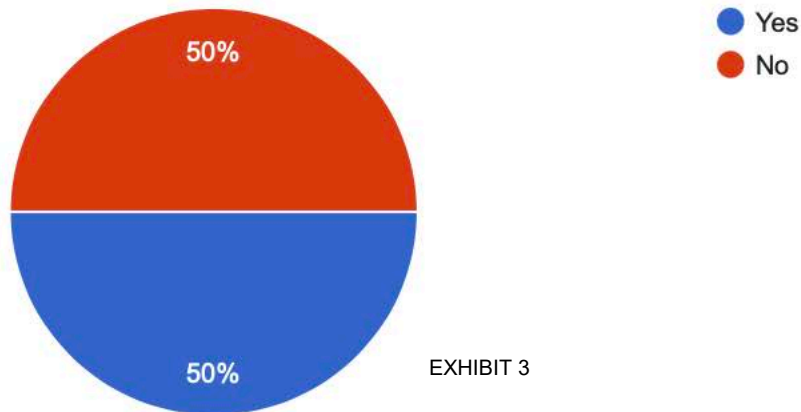
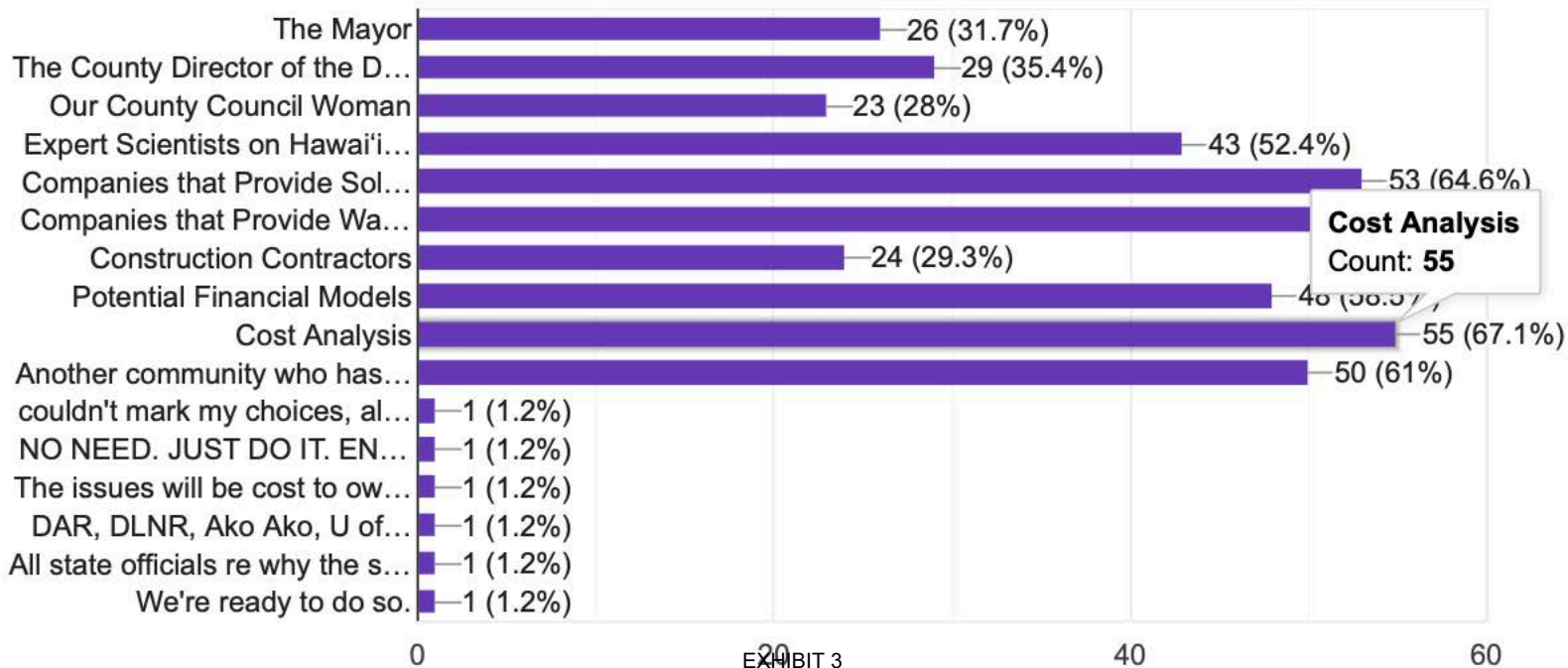


EXHIBIT 3

Who would you like to hear from on this topic to help you eventually make a decision to connect to a sewer system. Please check as many boxes as you wish.

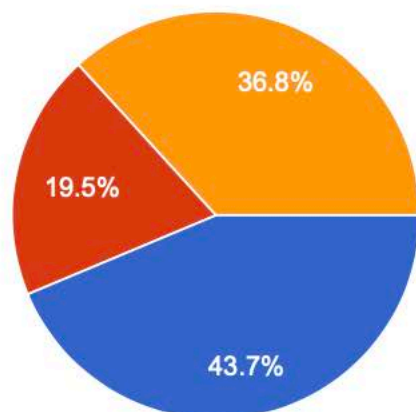
82 responses



Please share your concerns regarding:

The accuracy of the science regarding reef health and threats to the reef

87 responses

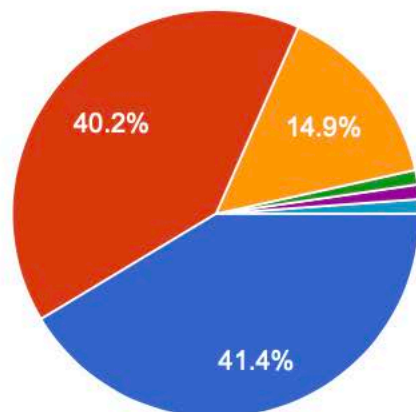


- 1 - Most Concerning
- 2 - Somewhat Concerning
- 3 - Not at all Concerning

Please share your concerns regarding:

Upfront cost of connecting to a sewer

87 responses



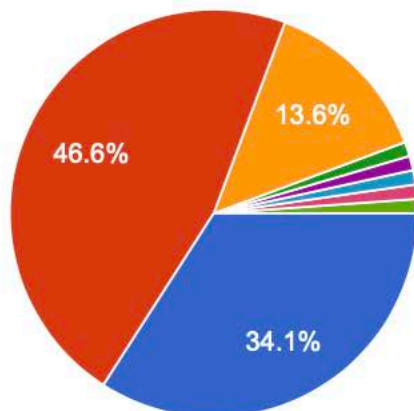
- 1 - Most Concerning
- 2 - Somewhat Concerning
- 3 - Not at all Concerning
- Puako is a marine protected area. I do not understand how we are not able to obtain state and federal grants given th...
- do not know
- Elimination of Cess Pools is a State Mandate and we see no effort by State or County to offer any form of incentives t...

Please share your concerns regarding:



Monthly usage costs

88 responses



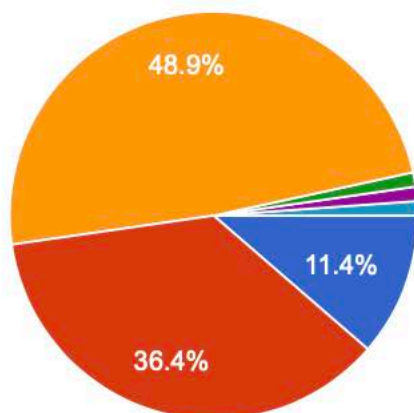
- 1 - Most Concerning
- 2 - Somewhat Concerning
- 3 - Not at all Concerning
- What happens for people who cannot or do not pay?
- Basically not concerned but don't know what the costs might be
- Again--not concerning if compares to n...
- do not know
- I don't know those costs

Please share your concerns regarding:



Disruption of the street

88 responses



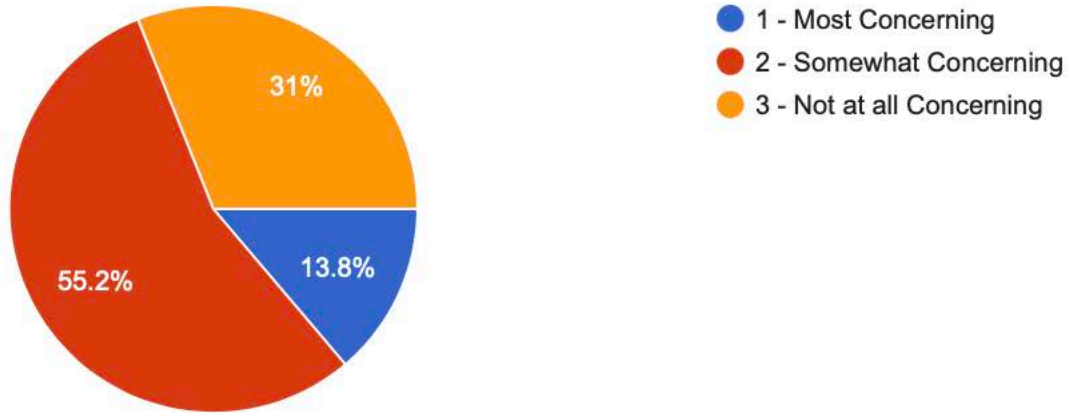
- 1 - Most Concerning
- 2 - Somewhat Concerning
- 3 - Not at all Concerning
- Ok for a good purpose.
- Depends on degree of disruption
- Not concerning as long as County will repave after work is completed with the transmission line install.

Please share your concerns regarding:

 Copy

Disruption of property

87 responses



Please list any other concerns:

27 responses

how to assist homes that can't afford a hookup

People who are happy with their cesspools.

Willingness of all residents to cooperate

How to get 100% adoption of new system within 24 months or less.

Not all property or users are equal. How will individuals be assessed?

The biggest concern is what happens if we do nothing

I do not believe this project can be accomplished until the Puako Community Assn(PCA) Board of Directors reverses its unfortunate decision to exclude non homeowners from their voting rights. The first annual meetings I attended in the 1990s has 75+ attendees, evenly split between renters and homeowners....this most recent meeting had less than 25 attendees..almost all of which were homeowners. We need the renters behind us to put pressure on the absentee homeowners to agree to a community treatment system.

Would like to attend PFR meetings via zoom

As a mainland resident, I would appreciate Zoom meeting accessibility.

Up to now, we're in theory mode. We'll need to know more about costs, what it means for individual properties, if/how Puako Beach Drive will once again be torn apart, and if/how plantings and walls on properties will be impacted.

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Can we see any sort of realistic timeline regarding how long we should expect this project to take? It seems to have been festering longer than I can remember with a lot of regurgitation of the problem and little movement towards real solutions.

Don't seek input on a proposed sewer system from any parties that might be conflicted (most of your options above).

The state has been doing limited water sampling along Puako for decades - this data would be helpful to have and to show the trends.

Thank you for getting this project moving! I support protecting the reef and restoring it.

we support but don't know what the best answer is

Would like to be involved in PFR committee but we're not full time residents so we would need to tailor our involvement to meet both the needs of the committee as well as our availability so not to drop a ball.

One last point, Carollo and Coral Reef Alliance before them, casually say that septic tank systems are better than cesspools but not much better. They present no data to support that assertion. If it were true, then our State government should come up with a much better statewide plan and we (PRF) should probably be addressing the bigger issue--protecting the 'Aina of Hawaii from an inadequate plan to eliminate cesspools.

My son and I come to Puako twice a year and rent condo out. This makes it difficult to attend meetings

I do not live full time in Puako but can be zoomed in!!!

Thank you for all of your work on this issue! It is incredibly important and has been needed for a long time. I hope that we can get started on a good waste disposal system for Puako in the near future.

Our community will probably not join in the sewer project but we do have concerns about the reef

You have a great group of committee members spearheading this effort to study the feasibility of a sewer system for Puako. I look forward to hearing the engineering report results, feasibility of the various options both from a construction and financial perspective.

Our family is very concerned about the reef and have seen it's quality and fish population decline. Though we spend some time in Puako we mostly rent our house. I live far away in Kentucky, otherwise I would try to be more involved and helpful.

I am an offsite resident and would not be able to attend meetings unless they were online.

The good faith estimate of 70% reef coverage declining to 7% over 50 years is probably reasonable and we would all like to see the reef in as good a shape now, as it was 50 or 100 years ago. We need the same good faith estimates (guesses) on the causes of the decline. What % is attributable to climate change/warming ocean, overfishing, runoff, cess pools, etc.

Many of the questions in this survey are poorly structured and designed to give a positive answer. Example: If affordable, would you switch your waste water treatment system to a sewer to protect and restore the reef? Everyone has a different view of "affordable". Voting no on this question puts the respondent in the position of saying they don't want to protect the reef. Everyone in Puako cares about the reef!!

Ellison, and Oprah, to name a few, have established foundations to assist with cleaning up the environment. The raw sewage that has almost destroyed the Puako reef system certainly counts as an environmental concern and may be of interest to these people. There are probably other sources of funding. Let's focus on trying to identify as many possible funding sources as we can.

We the property owners of Puako also need to pony up money to reclaim what was once an incredibly vibrant eco-system.

I also wonder what affect the large resorts, such as the Westin Hapuna Beach Resort, have had on the water quality here in Puako.

I appreciate all of the efforts of the PFR committee and the many hours they have spent on this.

HELLO. THIS IS NOT ROCKET SCIENCE. IT IS ESSENTIAL FOR PUAKO.HEALTH AND QUALITY OF LIFE. YOU CANT PUT A COST TO ENVIRONMENTAL INTEGRITY. PUAKO HAS THE FINANCIAL RESOURCES TO BUILD THIS SYSTEM. ALLOCATE COST BY SIZE OF HOME, ASSESSED VALUE AND LOCATION RELATIVE TO THE OCEAN. ITS A NO BRAINER!!!

stay the course

Thanks for your time and effort with this project!

This project is long overdue. Thank you for your efforts!

This is a huge issue for Hawaii and all ocean front Properties. It has been thrown around for decades with NO resolutions. One major unaddressed issue is limiting use of oceanfront properties. That should be addressed immediately. Most persons believe no limit is a fact already. Please think again.

I think there is no need to focus on "climate change" as the cause of the decline for the Puako reef system. The primary problem here in Puako has been, and continues to be, raw sewage damaging the reef system. Let's focus on what we can change in this regard.

There are many more sources of money than have been considered. Obviously the state of Hawaii has many issues it is trying to address and sees Puako as too small to provide any financial assistance. Even the county of Hawaii sees Puako as too small to assist. There are many very wealthy people who own property in the state who claim to want to protect the environment. People such as Mark Zuckerberg, Larry

We very strongly support transmission to the existing facility in Mauna Lani. In the early/mid 1980's when this plant was being built Tokyu offered to install the transmission line through Puako to handle their discharge at no cost. Unfortunately the Puako ownership at that time voted the offer down!!

EXHIBIT 3

timing--this has taken too long and is causing damage daily

Can we enlist philanthropists to contribute and/or developers? This burden should not be on all of the homeowners.

just a thought: is there any chance of avoiding sewers by having a community "pump out the septic tanks/cesspools" system where everyone contributes to continual removal of waste by pump trucks?

I would love more information about expected duration of disruption of road and monthly and yearly cost.

We're very concerned about the state of the reef. We're very concerned if this doesn't get done soon that the reef will continue to die.

Mostly the upfront cost issues.

EXHIBIT 3

Who will own and operate a new system for Puako?

Visual appearance and possible smell

We cannot weigh in on options without a reasonably concise cost-benefit analysis and info regarding available funding/financing of the project.

1) I'm not convinced the sewer system (both initial cost and ongoing maintenance) will impact water quality.

2) For a fraction of the sewer system cost, existing cesspools could be converted to septic systems?

What happens when a pressurized sewer line breaks? Mine or the community collection line? Who corrects the problem- is there a fine involved?

We simply do not have enough information to make any informed decisions at this time.

Very hard to answer questions without having cost analysis and environmental impacts of the options for each of the options to compare

That this hook up will take years and years to get started because the funding will not be available.

I abhor the SLOW PACE of progress!! Get it done. NOW. JUST DO IT. IT IS ESSENTIA AND NECESSARY. From a practical point of view, ODOR mitigation is at the top of any collection issues. I know from limited experience with waste water issues.

In order to make an informed decision, we need more information. I do think a sewage system would be far better than the current septic tank system so close to the ocean.. please give us more information on the cost of hooking up to the existing sewage system versus a plant near Puako and where that plant would be located and would there be smell or noise associated with that plant.

Seems definitely preferable to tie in to existing system which probably needs to be e-landed.

accurate cost to complete from Contractor that does any of the work.

long term maintenance, monitoring, durability and lifespan of system; active reef restoration

EXHIBIT 3

There are many other answers to saving the reef besides a sewer system

EXHIBIT 4

Chapter 32 Amendment

Objective:

- Clearly distinguish Council-initiated from petition-initiated;
- Introduce a step prior to the Resolution of Intention to analyze the feasibility for a Council-initiated CFD;
- Reference the revolving fund in 32-11 as a source of funding for the feasibility analysis.

Section 32-18. Institution of procedures.

~~(a)~~ The procedure for the establishment of a district may be instituted by the council on its own initiative or by petition.

(a) Council-Initiated. To evaluate the feasibility for the Council to initiate the procedure, the Council shall adopt a resolution of pre-intention to establish a district which shall do all of the following:

- (1) State the public purpose for the Council to initiate the procedure;
- (2) Describe the proposed district, whether it is an existing built community or undeveloped, and the landownership pattern;
- (3) Describe the nature of the problem to be addressed by establishing the district;
- (4) Specify the types of studies needed to determine the district boundaries, conduct a preliminary engineering study, identify alternative rates and methods of apportionment, and other pertinent studies to enable an estimation of the maximum special tax to be paid by the landowners within the proposed district;
- (5) Provide an estimated budget for the feasibility analysis and source of funding;
- (6) If the revolving fund specified in section 32-11 is the source of funding, appropriate the required moneys, and establish the method by, and term within which, the district is to reimburse the fund.
- (7) Provide a workplan, estimated schedule, and authorized parties to draw upon the funds to execute the workplan.

(b). Petition-Initiated. The Council shall institute at its next regular meeting for which notice has not yet been given, after receipt by the clerk of a petition requesting the institution of the procedure signed by the landowners owning the requisite portion of the area of the proposed district, as specified in paragraph (d) of section 32-19, accompanied by the payment of a fee (if any) which the County determines is necessary to compensate the County for costs expected to be incurred by the County in conducting the procedure to create a district pursuant to this chapter.

(C) No district shall be established unless the council finds that the establishment of such district is in the public interest. The council's findings shall be final and conclusive.

Resolution of Pre-Intention

DECLARING THE PRE-INTENTION OF THE COUNTY COUNCIL OF THE COUNTY OF HAWAII TO INITIATE A COMMUNITY FACILITIES DISTRICT FOR THE PUAKO COMMUNITY TO REPLACE ONSITE WASTEWATER DISPOSAL SYSTEMS WITH A COUNTY SEWERLINE IN ORDER TO RESTORE THE HEALTH OF THE NEARSHORE CORAL REEFS

WHEREAS, Puako reef is on the brink of collapse. Once vibrant with 70% coral coverage, it now has just 7%— a 90% loss in 50 years. Scientists warn if coverage drops below 5%, the reef may never recover, leading to irreversible ecological, economic, and cultural damage within 10 years if no action is taken. The reefs support over 7,000 species, protect shorelines, provide food security, support tourism, and hold deep cultural importance. Of the three main threats accelerating its decline, the major pollutant is the wastewater from onsite disposal systems based on bacteria levels and dye tests, and comparison to other reefs that are not exposed to wastewater and are recovering; the other two sources are storm runoff and overfishing.

WHEREAS, the State legislature, through Act 125/2017, mandated the closure of cesspools by 2050 recognizing the impact of cesspools on the nearshore coastal waters and groundwater. A study by the University of Hawaii updated the prioritization methods to identify the most vulnerable areas of contamination, ranking Puako in the highest Priority 1 category due to its impact on the precious coral reefs.

WHEREAS, the Puako community should be recognized for their proactive initiative and perseverance to raise millions of dollars to find a solution to save the reef over the past 12 years. Members of the Puako community formed a 501(c)(3) nonprofit corporation, Puako for Reefs (PFR), to forge ahead. This resolution is the County's expression of support, to move forward as partners to develop a replicable model for other communities to work together among themselves and with the County to replace onsite wastewater disposal systems with environmentally friendly wastewater disposal systems.

WHEREAS, the County's regional wastewater master plan for South Kohala recommended a low pressure sewer system (vs gravity system) due to the topography and shallow groundwater of Puako, and to connect to an existing private wastewater treatment plant (vs building a new County treatment plant). PFR has secured the preliminary consent from the owners of the Mauna Lani wastewater treatment plant to connect.

WHEREAS, PFR retained a special tax consultant and determined that a community facilities district (CFD), rather than an improvement district (ID), is more appropriate for Puako to more fairly allocate the financial cost to construct a sewer system among the diverse income range of the Puako homeowners.

WHEREAS, PFR has raised sufficient funds to carry out the planning phase to construct a low pressure system. Substantial additional funds are needed for the next detailed design phase and environmental compliance documentation in the order of \$1,000,000.

WHEREAS, the FY 2025-26 CIP budget included an appropriation for a revolving fund for cesspool closures identifying Puako as a priority for this funding. This resolution authorizes and implements the revolving fund pursuant to HCC 32-11. The fund would be repaid upon the establishment of a CFD for Puako and issuance of the CFD bond ordinance.

WHEREAS, provided that the plans and studies funded through the revolving fund verify the establishment of a CFD for Puako, the findings will be reported in the Resolution of Intent, pursuant to HCC 32-18 to proceed with the process to establish a CFD for Puako.

BE IT RESOLVED BY THE COUNCIL OF THE COUNTY OF HAWAII that:

1. County-Initiated CFD. Based on the public purpose set forth herein, the County hereby initiates the process to create a CFD to construct a low-pressure sewerline for the Puako community connecting to the private Mauna Lani wastewater treatment plant.
2. Public Purpose. The regional benefits ramifying from this Puako sewerline CFD extend beyond the community including: restoring the public trust resource of the Puako coral reefs, improving the public health water quality of the nearshore coastal waters, providing infrastructure that can accommodate the future connection of other communities and public properties that impact the coastal water quality, and blazing a trail of lessons learned for other communities to initiate action for the betterment of future generations.
3. Reasons for a CFD. The complexity of the several pertinent factors that exist in Puako that could affect the rate and method of payment justifies the more flexible CFD over an improvement district that would be verified through a study by a special tax consultant.
4. Studies Needed. In order to estimate the total cost, the studies needed for the initial planning phase include a preliminary engineering report by an engineer, evaluation of alternative methods of apportionment by a special tax consultant, scope of environmental review by a planner, and outreach to the community by a community engagement consultant. The County will need its own consultants to conduct its due diligence studies including without limitation their own special tax consultant and bond counsel. Upon resolving certain threshold issues, the County will notify PFR to proceed with the design phase that would include the preparation of construction documents and environmental assessment.
5. Budget. The total budget to initiate the CFD is \$1,240,000, with the planning phase at \$190,000, the County's due diligence at \$100,000, and the design phase at \$950,000 (see Exhibit A).
6. Revolving Fund. The FY 2025-26 CIP Budget appropriated \$1,000,000 for a revolving fund that is hereby directed to be used for the planning and engineering of the facilities for the Puako CFD. The revolving fund shall be reimbursed within five (5) years upon the closing of the loan that would be repaid through the CFD, or other proceeds from the CFD.
7. Workplan. Exhibit B is a workplan outlining the tasks and assignments to establish the CFD, estimated to require approximately three (3) years.

8. Council hereby directs the Finance Director to fund and manage the revolving fund to hire consultants or issue draws to PFR within the budget set forth in this Resolution, and to submit a report to the Council with findings and recommendation whether to proceed with the CFD.
9. This Resolution shall take effect immediately upon its adoption.

Dated at Hilo, Hawaii, this __ day of _____, 2025.

INTRODUCED BY:

James Hustace, Councilmember

EXHIBIT A: BUDGET

	Year 1	Year 2	<i>Subtotal</i>
Planning Phase			<i>\$190,000</i>
Preliminary engineering report	\$85,000		
Alternative rates and methods analysis	\$45,000		
Scope of environmental review analysis	\$20,000		
Community engagement	\$40,000		
County due diligence	\$75,000	\$25,000	<i>\$100,000</i>
Design Phase			<i>\$950,000</i>
Construction documents		\$700,000	
Environmental assessment		\$250,000	
<i>Subtotal</i>	<i>\$265,000</i>	<i>\$975,000</i>	
Funding Source			
PFR advance from donations	\$265,000		
Revolving fund		\$975,000	
<i>Total</i>			<i>\$1,240,000</i>

EXHIBIT B: WORKPLAN

	Task	Assigned To	Start	End	Dur	%				
							2025	2026	2027	2028
	County-Initiated CFD		1/1/25	10/13/28	984					
1	Planning Phase	PFR	1/1/25	12/31/25	257					
1.1	Preliminary engineering report	Engineer	1/1/25	8/1/25	153					
1.2	Alternative rates and methods analysis	Special Tax Consultant	3/1/25	8/1/25	110					
1.3	Scope of environmental review analysis	Planning Consultant	5/1/25	8/1/25	67					
1.4	Community engagement	Community engagement consultant	7/1/25	12/31/25	128					
2	County Due Diligence	Finance Dept	7/1/25	12/1/25	107					
2.1	Threshold questions/issues	Finance Dept	7/1/25	10/1/25	67					
2.2	Other findings	Finance Dept	7/1/25	12/1/25	107					
3	Design Phase	PFR	3/27/26	9/30/26	134					
3.1	Construction documents	Engineer	3/27/26	9/30/26	134					
3.2	Environmental assessment	Planning Consultant	3/27/26	9/30/26	134					
4	Construction Phase	DEM	10/1/26	2/2/28	350					
4.1	Bid/award	DEM	10/1/26	12/24/26	61					
4.2	Construction	Contractor	12/25/26	2/1/28	288					
4.3	Substantial completion	Contractor	2/2/28	2/2/28						
5	CFD Process		10/2/25	10/13/28	788					
5.1	Resolution of Intent	Council	10/2/25	12/31/25	61					
5.2	Public hearing	Council	1/1/26	3/26/26	61					
5.3	Ordinance of Formation	Council	2/2/28	4/26/28	61					
5.4	Loan closing/bond ordinance	Finance Dept	4/27/28	7/20/28	61					
5.5	Reimbursement to revolving fund	Finance Dept	7/21/28	10/13/28	61					

CFD (Chapter 32) vs ID (Chapter 12)

Method of Apportionment Comparison

CFD (Chapter 32)	ID (Chapter 12)
<p>Section 32-30. Special tax; apportionment. There is <i>no requirement that the special tax imposed pursuant to this chapter be fixed in amount or apportioned on the basis of special benefit to any property or that the facility to be financed convey a special benefit on any property in the district.</i> It shall be sufficient that the council determines that the property to be subject to the special tax is improved or benefitted in a general manner or in any other manner. Notwithstanding anything to the contrary contained in this chapter, the facilities to be financed may be located outside of the district and may also benefit property outside the district. However, a special tax levied pursuant to this chapter may be based on benefit received by parcels of real property, or the cost of making facilities available to each parcel, or the stage or type of development or use of each parcel, or wholly or partially contingent as to all or certain parcels on the happening of one or more specified events related to the development or improvement of such parcels, or any other reasonable basis or formula as determined by the council, and any determination of the reasonableness of any special tax or the basis or method of the apportionment thereof by the council shall be final and conclusive. (1994, ord 94-77, sec 3.)</p>	<p>Section 12-2. Method; authority to issue bond.</p> <p>(a) Whenever in the opinion of the council it is desirable to make any special improvement in any improvement district, the special improvement shall be made and done under the provisions of this chapter. The cost of the special improvement including the cost of acquiring (whether prior to or after the commencement of the proceedings for such improvements) any new land therefor, <i>shall be assessed against the assessment unit specially benefited on the basis of any method or methods which the council finds assesses the assessment unit according to the special benefits conferred thereon</i>, which may include, without limitation, any of the following:</p> <ol style="list-style-type: none"> (1) Frontage; (2) The area of the assessment unit; (3) The permissible number of dwelling units permitted on each parcel under applicable zoning provisions; (4) The amount of water allotted to each assessment unit; (5) Minimum required sewer capacity of the assessment unit; (6) Traffic generation/usage for road improvements; (7) The square footage of buildings and/or other improvements; or (8) Any other method that the council finds assesses said assessment units according to the special benefits conferred on said assessment units or any combination thereof. <p>(b) Any provision or section to the contrary notwithstanding, in determining the applicable method of assessment for any improvement district under subsection (a) above, the council may, in its discretion, give</p>

	<p>consideration to the following, if applicable:</p> <p>(1) In the case of assessment units or classes of assessment units having different uses which affect the nature or extent of the special benefits to be conferred thereon by the proposed special improvements, the method of determining the assessments against such assessment units or classes of assessment units may vary based on their respective uses to the extent that the council deems appropriate in order to reflect the special benefits conferred thereon.</p> <p>(2) In addition, if a change in classification or use is reasonably anticipated with respect to specified assessment units that will result in increased special benefits conferred thereon, the council may designate such assessment units as affected assessment units with respect to the anticipated change in classification or use, in which case the assessments against such affected assessment units shall be subject to change upon the effectiveness of the anticipated change in classification or use to reflect the increased special benefits; provided that the change in assessments on the affected assessment units is authorized in the resolution creating the improvement district pursuant to section 12-18 and the ordinance fixing the assessments for the improvement district pursuant to section 12-29.</p>
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EXHIBIT 6

Puako Sewerline Design/Construction/Financing Process

Project Schedule

1. Overview

- a. Attached are a Gantt chart and associated process diagram that would be updated as needed throughout the process. The process is anticipated to take three years (2025 to 2028) to complete construction and start hookups.
- b. The project schedule delineates four tracks that run concurrently:
 - i. *Design/Construction*. The engineer starts this track with the preliminary engineering followed by construction documents and securing applicable permits. The County would then bid and award the project. The County would issue a notice to proceed to the selected contractor when financing is in place.
 - ii. *Environmental Assessment*. The planner carries out the EA steps starting with background studies (e.g., archaeological and cultural impact research, coastal water impact) concurrently with consultation with interested parties to identify issues and concerns, then prepares a Draft EA that is open to public review, concluding with a Final EA that addresses the comments submitted during the review period. There are different requirements for a State (HRS chapter 343) vs a federal EA (NEPA) that can be combined into a single document, with the federal EA triggered by federal funding as applicable (USDA and/or EPA).
 - iii. *Community Facilities District (CFD)*. The special tax consultant prepares a feasibility study based on the cost estimates provided by the engineer, followed by a formalized report called a Rate and Method of Apportionment (RMA). The RMA proposes the special tax rate that each class of property owners within the CFD boundaries would pay.
 - iv. *USDA*. The USDA requirements are onerous, but may be worth the effort depending on the loan interest rate (and assuming the Project area's income would not qualify for a grant). The application includes the EA and Preliminary Engineering Report (PER). Upon approval of the application, the USDA would issue a Letter of Commitment setting forth terms of the financing (e.g., loan amount, interest rate). The loan would close based on the award if the loan covers the construction cost, or upon completion based on the final completed cost if there is another source for the construction financing.
- c. The project schedule proposes five community meetings at strategic points in the process, as noted below.

2. 2025

- a. Q1: Mobilize the Project by meeting with the County to gain their support and retain the consultant team (engineer, planner, special tax consultant). Determine whether to apply for the USDA funding and clarify applicable requirements.

- b. *By the end of the year*: Complete the PER, Draft EA, and RMA. Initiate the CFD petition at Council based on the PER and RMA.
 - c. *Community Meetings*: Hold community meetings prior to the introduction of the Resolution of Intent and prior to the public release of the Draft EA.
- 3. 2026**
- a. *Q1*: Complete the Final EA and submit the USDA application, as applicable.
 - b. *By the end of the year*: Obtain USDA's final approval (called the Letter of Commitment), complete the construction documents and obtain a bid price, adopt the Ordinance of Formation for a CFD.
 - c. *Community Meetings*: Update the community with the bid costs and USDA's letter of commitment, as applicable.
4. **2027**: The County would consummate a construction contract and start construction, estimated to take one year to completion. The contractor would hold a community meeting to inform the community of the construction steps and time.
5. **2028**: Complete construction and start hookups. The nonprofit would hold a community meeting to coordinate the hookups.

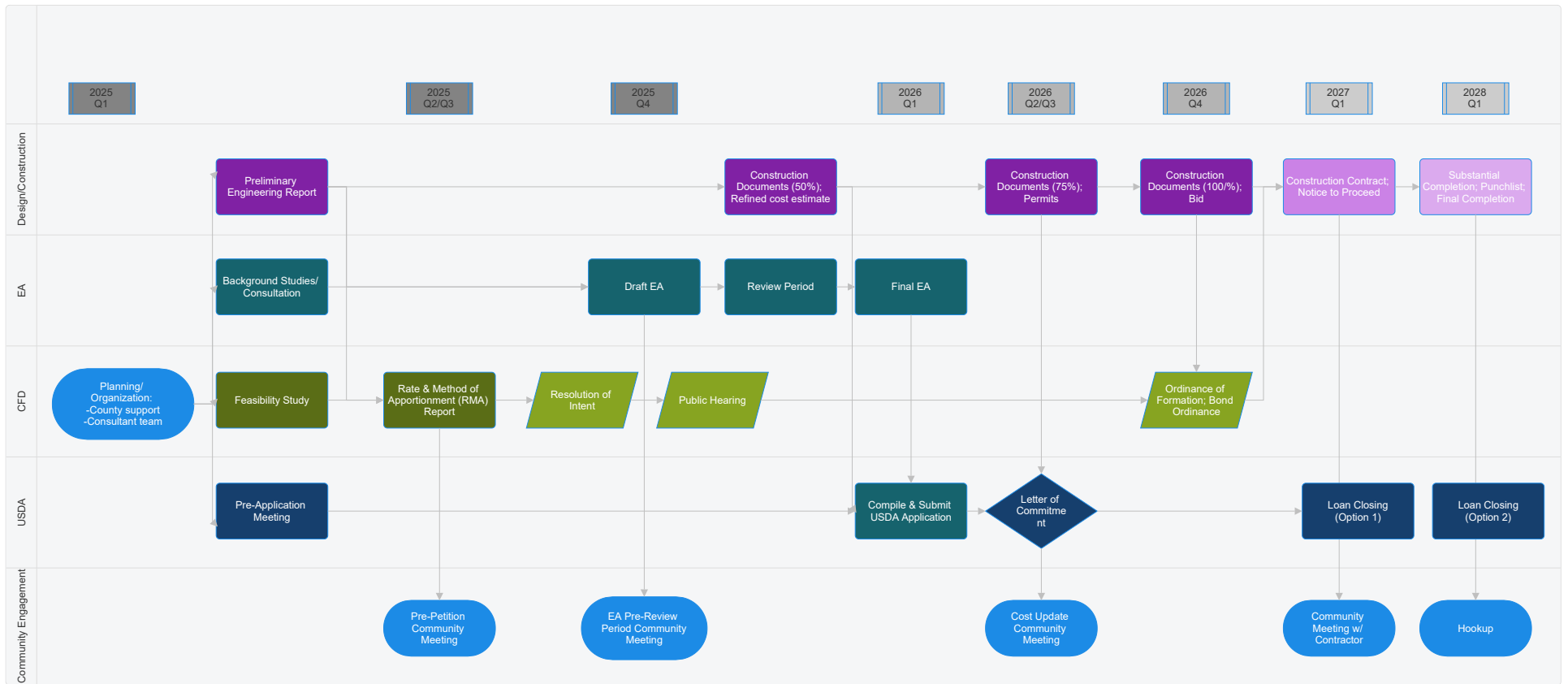
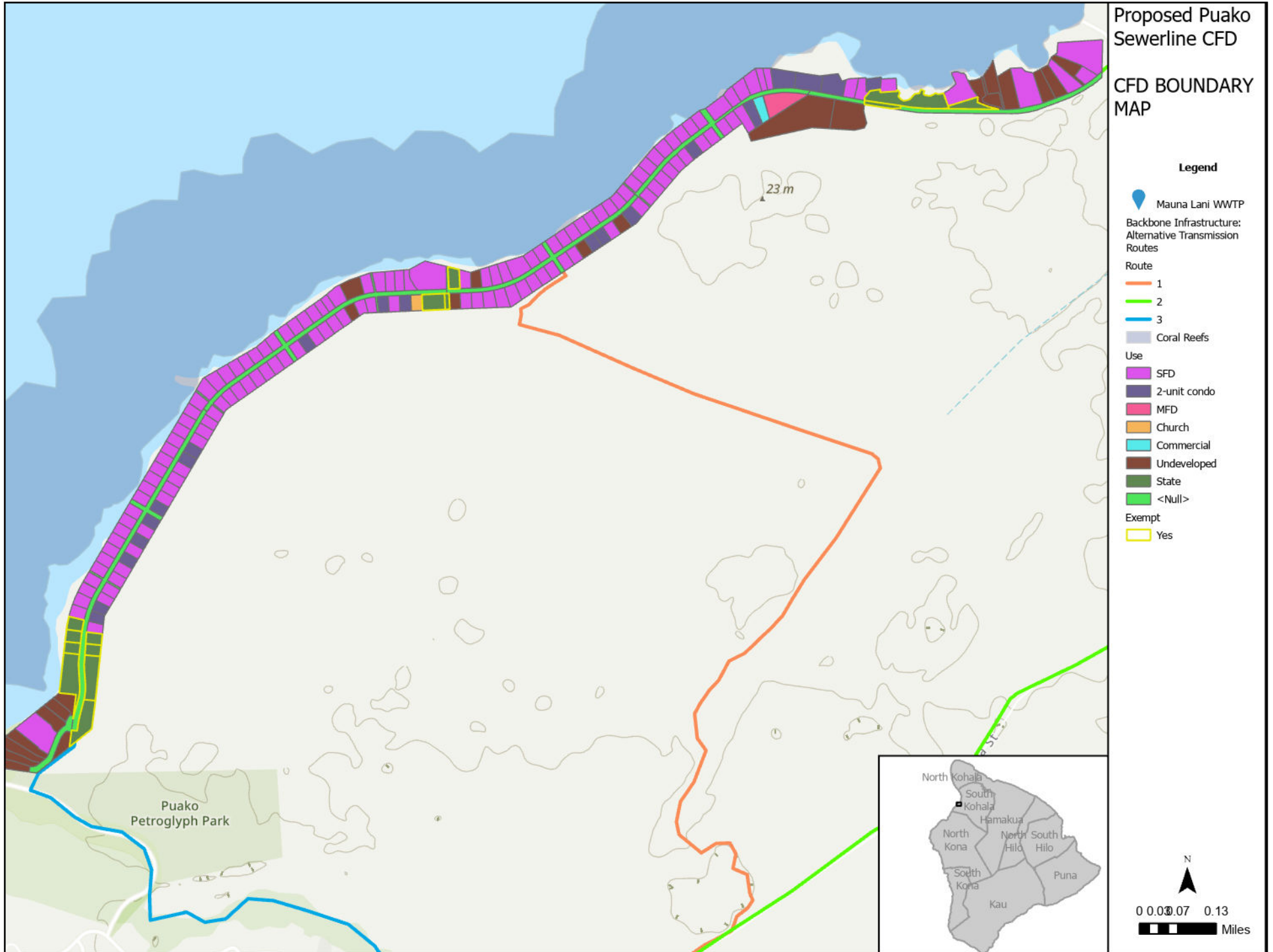


EXHIBIT 6

	Task	Assigned To	Start	End	Dur	2025				2026				2027			2028			
						Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
	Puako Sewer Project		2/1/25	6/19/28	881															
1	Planning/Organizing		2/1/25	4/15/25	51															
1.1	County support		2/1/25	3/22/25	35															
1.1	Mayor's office (meeting w/ Deputy Managing Director)	Steering Committee	2/1/25	2/12/25	7															
1.1	Meeting w/ Department heads (DEM, Finance, Corp Counsel)	Steering Committee	2/12/25	3/4/25	14															
1.1	Meeting w/ County Council (Hustace)	Steering Committee	3/4/25	3/22/25	14															
1.2	Retain consultants		3/4/25	4/15/25	30															
1.2	Engineer (preliminary engineering report, construction documents)	Steering Committee	3/4/25	4/15/25	30															
1.2	Planner (EA, USDA application)	Steering Committee	3/4/25	4/15/25	30															
1.2	Special Tax Consultant (CFD)	Steering Committee	3/4/25	4/15/25	30															
2	Design		4/15/25	11/23/26	419.5															
2.1	Preliminary Engineering Report		4/15/25	9/9/25	105															
2.1	Draft PER	Pederson	4/15/25	6/17/25	45															
2.1	Revised Draft PER	Pederson	6/17/25	7/29/25	30															
2.1	Final PER	Pederson	7/29/25	9/9/25	30															
2.2	Construction Documents		9/9/25	3/10/26	130															
2.2	75%	Pederson	9/9/25	1/27/26	100															
2.2	Review and cost estimate	Pederson	1/27/26	3/10/26	30															
2.2	100%	Pederson	11/22/25	1/19/26	41															
2.3	Bid & award	County DPW	1/20/26	9/28/26	180															
2.4	Construction contract	County DPW	9/29/26	11/23/26	40															
2.5	Permits	Pederson	1/27/26	4/21/26	60															
3	Environmental Assessment (State & Federal)		4/15/25	2/24/26	225															
3.1	Background studies	Planner	4/15/25	7/8/25	60															
3.2	Consultation period	Planner	7/8/25	8/19/25	30															
3.3	Draft EA	Planner	8/19/25	11/11/25	60															
3.4	Review Period	Planner	11/11/25	1/13/26	45															
3.5	Final EA	Planner	1/13/26	2/24/26	30															
4	Community Facilities District (CFD)		6/17/25	11/5/26	362															
4.1	CFD feasibility analysis	Goodwin	6/17/25	9/9/25	60															
4.2	CFD Rate & Method of Apportionment Report (RMA)	Goodwin	9/9/25	12/2/25	60															
4.3	Compile CFD petition supporting documentation	Steering Committee	12/2/25	1/13/26	30															
4.4	Resolution of Intent	County Council	1/13/26	4/7/26	60															
4.5	Public Hearing	County Council	4/7/26	6/30/26	60															
4.6	Ordinance of Formation	County Council	6/30/26	9/24/26	62															
4.7	Bond Ordinance	County Council	9/24/26	11/5/26	30															
5	USDA Loan		2/1/25	9/22/26	426.5															
5.1	Determine eligibility and loan terms	USDA	2/1/25	2/11/25	7															
5.2	Pre-application meeting	Steering Committee	3/4/25	3/22/25	14															
5.3	Compile application package	Planner	2/24/26	4/7/26	30															
5.4	USDA review & approval	USDA	4/7/26	6/30/26	60															
5.5	Letter of Commitment	USDA	6/30/26	9/22/26	60															
6	Community Engagement		6/17/25	4/7/26	210															
6.1	Pre-petition meeting	Steering Committee	6/17/25	7/15/25	20															
6.2	EA review period community meeting	Steering Committee	11/11/25	12/9/25	20															
6.3	Post-public hearing cost update meeting	Steering Committee	3/10/26	4/7/26	20															
7	Construction		11/24/26	3/27/28	350															
7.1	Notice to Proceed	County DPW	11/24/26	1/4/27	30															
7.2	Substantial Completion	Contractor	1/5/27	12/6/27	240															
7.3	Punchlist	Contractor	12/7/27	2/28/28	60															
7.4	Final Completion	Contractor	2/29/28	3/27/28	20															
8	Hookup & Grinder Pump Maintenance Assistance	Steering Committee	3/28/28	6/19/28	60															

EXHIBIT 6



TMK	Use	Units
369001007	Undeveloped	1
369001018	Undeveloped	1
369001020	Undeveloped	1
369001021	SFD	1
369001023	Undeveloped	1
369001024	Undeveloped	1
369001025	Undeveloped	1
369001026	Undeveloped	1
369001027	Undeveloped	1
369002001	SFD	1
369002002	SFD	1
369002003	Undeveloped	1
369002004	Undeveloped	1
369002005	SFD	1
369002011	SFD	1
369002012	2-unit condo	2
369002013	2-unit condo	2
369002023	Undeveloped	1
369002024	Undeveloped	1
369002025	Undeveloped	1
369002026	SFD	1
369002027	Undeveloped	1
369002030	SFD	1
369002031	SFD	1
369002033	Undeveloped	1
369002034	SFD	1
369002035	Undeveloped	1
369002036	Undeveloped	1
369003001	SFD	1
369003002	SFD	1
369003003	SFD	1
369003004	SFD	1
369003005	SFD	1
369003006	SFD	1
369003007	SFD	1
369003008	SFD	1
369003009	SFD	1
369003010	SFD	1
369003012	SFD	1
369003013	SFD	1
369003014	SFD	1
369003015	SFD	1

TMK	Use	Units
369003016	2-unit condo	2
369003018	2-unit condo	2
369003019	MFD	38
369003022	Commercial	1
369003023	2-unit condo	2
369003024	SFD	1
369003025	SFD	1
369003026	SFD	1
369003027	SFD	1
369003028	SFD	1
369003029	2-unit condo	2
369003030	SFD	1
369003031	SFD	1
369003032	SFD	1
369003033	SFD	1
369003034	SFD	1
369003035	SFD	1
369003036	SFD	1
369004002	SFD	1
369004003	Undeveloped	1
369004004	SFD	1
369004005	SFD	1
369004006	SFD	1
369004007	SFD	1
369004009	SFD	1
369004010	SFD	1
369004011	SFD	1
369004012	SFD	1
369004013	SFD	1
369004014	SFD	1
369004015	SFD	1
369004016	SFD	1
369004017	SFD	1
369004018	SFD	1
369004019	SFD	1
369004020	SFD	1
369004021	2-unit condo	2
369004022	Undeveloped	1
369004023	SFD	1
369004024	2-unit condo	2
369004025	2-unit condo	2
369004026	Undeveloped	1

TMK	Use	Units
369004027	SFD	1
369004028	SFD	1
369004029	SFD	1
369004030	SFD	1
369004031	SFD	1
369004032	SFD	1
369004033	SFD	1
369004034	SFD	1
369004035	SFD	1
369004036	SFD	1
369004037	SFD	1
369004038	Undeveloped	1
369005001	SFD	1
369005002	SFD	1
369005003	SFD	1
369005004	SFD	1
369005005	SFD	1
369005006	SFD	1
369005007	SFD	1
369005008	SFD	1
369005009	SFD	1
369005010	SFD	1
369005011	SFD	1
369005012	SFD	1
369005013	SFD	1
369005014	Undeveloped	1
369005015	SFD	1
369005016	SFD	1
369005017	SFD	1
369005018	SFD	1
369005020	SFD	1
369005021	Church	1
369005022	2-unit condo	2
369005023	SFD	1
369005024	2-unit condo	2
369005025	SFD	1
369005026	SFD	1
369005027	Undeveloped	1
369005028	SFD	1
369005029	SFD	1
369005030	SFD	1
369005031	SFD	1

TMK	Use	Units
369005032	2-unit condo	2
369005033	SFD	1
369005034	SFD	1
369005035	SFD	1
369005036	SFD	1
369005037	SFD	1
369005038	SFD	1
369005039	SFD	1
369005040	SFD	1
369005041	SFD	1
369005042	SFD	1
369005043	SFD	1
369005048	SFD	1
369006004	SFD	1
369006005	SFD	1
369006006	SFD	1
369006007	SFD	1
369006008	SFD	1
369006009	SFD	1
369006010	SFD	1
369006011	SFD	1
369006012	SFD	1
369006013	SFD	1
369006014	SFD	1
369006015	SFD	1
369006016	SFD	1
369006017	SFD	1
369006018	SFD	1
369006019	SFD	1
369006020	SFD	1
369006021	SFD	1
369006022	SFD	1
369006023	SFD	1
369006024	SFD	1
369006025	SFD	1
369006026	SFD	1
369006027	SFD	1
369006028	SFD	1
369006029	SFD	1
369006030	2-unit condo	2
369006031	2-unit condo	2
369006032	SFD	1

TMK	Use	Units
369006033	SFD	1
369006034	SFD	1
369006035	SFD	1
369006036	2-unit condo	2
369006037	2-unit condo	2
369006038	SFD	1
369006039	2-unit condo	2
369006040	SFD	1
369006041	2-unit condo	2
369006042	SFD	1
369006043	SFD	1
369006044	SFD	1
369006045	SFD	1
369006046	2-unit condo	2
369006047	2-unit condo	2
369006048	SFD	1
		241
Exempt		
369001028	Roads	0
369002014	Roads	0
369002999	Roads	0
369003999	Roads	0
369004999	Roads	0
369005999	Roads	0
369006999	Roads	0
369002006	State	1
369002009	State	1
369002010	State	1
369004001	State	1
369005019	State	1
369005046	State	1
369006001	State	1
369006002	State	1
369006003	State	1
369006049	State	1
369006050	State	1
369006051	State	1
369006052	State	1
369006053	State	1
		14

EXHIBIT 8

JPE
CIVIL AND ENVIRONMENTAL ENGINEERING
POBOX 551751
Kapa'au HI 96755
808-854-4888

MEMO

To: Puakō for Reefs

From: Jim Pedersen, PE

Date: March 14, 2025

Subject: Puakō Wastewater Infrastructure Preliminary Engineering

INTRODUCTION

Puakō for Reefs (PFR), representing the Puakō community, is investigating potential improvements to the area's wastewater infrastructure. Currently, the community lacks a centralized system for sewage collection and treatment. Instead, hundreds of closely spaced residences each manage their own waste through individual systems, such as aeration treatment units, septic tanks, or cesspools with below-grade disposal.

PFR is exploring the possibility of implementing a centralized system to collect and treat sewage, thereby minimizing its environmental impact and ensuring proper disposal of the treated wastewater. However, PFR does not intend to be directly involved in the treatment process or the disposal of treated effluent.

A key advantage for Puakō is the nearby Mauna Lani wastewater treatment plant (WWTP), which has additional available capacity. PFR has engaged JPE to develop a solution for conveying sewage through a low-pressure system from the individual residences to the Mauna Lani WWTP.

The proposed collection and conveyance system will involve two main components: (1) modifications on individual properties to direct sewage to the right-of-way, and (2) infrastructure within the right-of-way to transport the sewage to the WWTP. Previous studies considered a gravity sewer and pump station system; however, it was deemed cost-prohibitive.

INDIVIDUAL PROPERTY WORK

To implement the centralized sewage collection system in Puakō, each property will require the installation of an individual pump station. JPE evaluated two types of pump stations: Septic Tank Effluent Pump (STEP) systems and grinder pump stations. Based on the analysis, STEP systems were

identified as the preferred solution for Puakō. These systems are ideal for phased implementation and capable of transporting sewage the full distance to the Mauna Lani WWTP. STEP systems retain almost all solids in the septic tank making it easier to size the system for total demand and gradually install the system over time. Additionally, STEP systems are a cost-effective option with less frequent replacement or repair needs. A STEP system will not require additional infrastructure, such as a community pump station with long-term maintenance requirements.

While STEP systems offer several benefits, there are some considerations. For example, unless a community management program is implemented, individual households will need to arrange for septic tank pumping and incur those additional costs. The frequency of pumping depends on the number of occupants, their usage habits, and the size of the tank. One can approximate a pumping every three to five years although with proper monitoring that could be extended to every ten years. Additionally, the size of the STEP system may present challenges in terms of finding suitable space on some properties. Electricity will be required, however these small pumps have a minimal impact on power consumption.

Components of Individual Pump System

Each home requires the following key components:

- 1) The existing sewer pipe serving the home, directed to the pump station
- 2) A septic tank with effluent filter
- 3) A new pump basin vault with pumps and float switch assembly (this could be added to an existing tank, installed downstream of an existing tank, or included in a new tank)
- 4) A new control panel (typically mounted on the side of the house)
- 4) A new 1.25" high-density polyethylene (HDPE) pipe routed from the pump station to the parcel property line at the new lateral connection.

In most cases, the 1,000-gallon tank is recommended (e.g., a Prelos Tank by Orenco, as shown in Appendix A, which comes with a complete pump package and all necessary accessories). The 1,500-gallon tank is recommended for homes with five or more occupants and/or homeowners who prefer to have their tank pumped out less frequently. The item price is similar, however, given the size of the larger tank, the installation may be challenging and therefore more expensive. For either size of tank, the installation process is more direct, and most likely less expensive, if the tank can be positioned between the home and the street as opposed to the rear of the yard. This should also reduce other impacts to landscaping or onsite repairs.

In situations where space is limited, it may be more practical to reuse an existing septic tank and install a separate, external pump basin to house the pump and accessories. In these cases, and after the existing tank is inspected and certified operational, only the pump package and the pump basin would be required. Similarly, for homes currently operating an aerobic treatment unit (ATU), it may be possible to install the pump package and the pump basin only, downstream of the existing ATU. When an

existing tank is proposed for reuse it should be noted that the existing system may need modifications in order to work with the new installed pump package. These situations will have to be detailed on an individual case by case basis.

For comparison, a portion of a budgetary equipment quote, provided by Orenco, a manufacturer of STEP systems, is shown in Table 1 below.

Orenco Item Code	Description	Quantity	Price
Prelos1000-18	Prelos Processor - 1000 Gallon with 18" Tall Riser	1	\$7,100.00
Prelos1500-18	PRELOS1500: Vault, filter, floats in tank.30" Riser with ClickTight and HDA riser adapters installed	1	\$8,100.00
LOS Pump Package	PF100511CV-CLK, S1-HR, PVU68-1819-L, FS-39 w/ 3x MF1p-CLK, CLK3-60, HDAS30125FCASLC-32	1	\$3,192.56
30" External Tank Pump Basin	PBF3084+COV+CLK+12	1	\$1,737.78

Table 1: Budgetary Equipment Quote

The work required for, and the impact at each property will vary, from one property to another. As a result the total installation cost will be based on several factors including but not limited to:

- 1) Location of the sewer line exiting from the house
- 2) Location of the existing wastewater treatment system
- 3) Available space around the house for equipment location and access
- 4) Distance to the right-of-way
- 5) Interference with driveways, fences, or other structures
- 6) Groundwater levels during pump station installation
- 7) Distance from the electrical breaker panel to the pump station control panel.

In order to proceed with a project baseline the estimated total cost for installing a new pump station after an existing tank and a standard installation of a new 1000 gallon tank and pump system is shown in Table 2a and Table 2b, respectively. Landscaping costs and any individual property specific repair costs are not included in these estimates.

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Item	Qty.	Units	Material		Labor		Subtotal
			Unit Price	Total	Unit Price	Total	
LOS Pump Basin System	1	LS	\$4,930	\$4,930	\$4,000	\$4,000	\$8,930
Shipping and Assembly	1	LS	\$500	\$500			\$500
Home Lateral Work to Tank	25	LF	\$20	\$100	\$100	\$500	\$600
1.25" HDPE pipe to ROW	150	LF	\$10	\$1,500	\$40	\$6,000	\$7,500
Electrical Work	1	LS	\$500	\$500	\$1,250	\$1,250	\$1,750
Cleanup/Demolition of Ex. System	1	LS	\$400	\$400	\$500	\$500	\$900
Contingency	1	LS	\$1,250	\$1,250	\$1,250	\$1,250	\$2,500
Subtotal							\$22,680
Hawaii GET	4.7%						\$1,066
TOTAL							\$23,746

Table 2a: Puakō Individual Home Estimate for STEP System (Existing Tank)

Item	Qty.	Units	Material		Labor		Subtotal
			Unit Price	Total	Unit Price	Total	
PreLOS Tank and Pump System	1	LS	\$7,100	\$7,100	\$5,000	\$5,000	\$12,100
Tank Shipping and Assembly	1	LS	\$1,800	\$1,800			\$1,800
Home Lateral Work to Tank	25	LF	\$20	\$500	\$100	\$2,500	\$3,000
1.25" HDPE pipe to ROW	150	LF	\$10	\$1,500	\$40	\$6,000	\$7,500
Electrical Work	1	LS	\$500	\$500	\$1,250	\$1,250	\$1,750
Cleanup/Demolition of Ex. System	1	LS	\$800	\$800	\$2,000	\$2,000	\$2,800
Contingency	1	LS	\$1,250	\$1,250	\$1,250	\$1,250	\$2,500
Subtotal							\$31,450
Hawaii GET	4.7%						\$1,478
TOTAL							\$32,928

Table 2b: Puakō Individual Home Estimate for STEP System (New Tank)

Individual Property Site Plans

The next step for individual property concerns is to develop a site specific parcel map for each lot. Most likely this will be coordinated through a questionnaire distributed to each owner along with a preliminary take on the individual property site plan for each parcel. An example of one of these site plans is shown on the next page. There is always a benefit to any existing plans on record. Although not always representative of what was actually built, a request for recent plans, if available, will be included.

It is expected that this effort would begin with the Puakō property owners with a supporting interest in the project. The main goal of this survey would be to determine the type and location of the current individual wastewater system (IWS) as well as its related sewer piping from the house.

An initial attempt was made to setup a block of twenty or so parcels. These were generated using the TMK parcel information available from the County of Hawaii Real Property Tax Office website. If the County information includes a shapefile for the permitted buildings then that information is included and referenced. If the County does not include the building information then any existing buildings were simply added from satellite imagery and labeled accordingly. Driveway locations were shown as approximate based upon Google Street View supplied images. These are not always clear, although it was thought that showing driveway locations might assist the owner with locating the additional information requested.

It should be noted that there are approximately 20 Condominium Property Regime (CPR) lots within the Puakō Beach Lots. These cases may complicate the process as it is likely the separate homes currently share infrastructure as well as parcel numbers.

Additionally, the State of Hawaii Department of Health records at least 15 properties on Puakō Beach Drive with a Wastewater Variance issued or pending. Most likely these variances include language requiring connection to a sewer service system should it become available to the area.

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① **SITE PLAN**
 1" = 30'-0" WHEN PRINTED AT 8.5X11



NOTES :

1. PROPERTY LINE DATA OBTAINED FROM THE COUNTY OF HAWAII REAL PROPERTY TAX OFFICE'S ONLINE MAPPING PLATFORM.
2. SATELLITE IMAGERY UTILIZED FOR GENERAL SITE CONTEXT AND REFERENCE, SOURCED FROM GOOGLE EARTH PRO.
3. STRUCTURE LOCATIONS AND SHAPES ARE APPROXIMATE, DELINEATED BY INFORMATION FROM THE COUNTY OF HAWAII REAL PROPERTY TAX OFFICE.

JOHN J HUGGINS

SITE PLAN

69-1757 PUAKO BEACH DRIVE

TMK : (3) 6 - 9 - 004 : 032

JPE NUMBER : 24-121

DATE : 11/17/2024

DRAWN BY : JG

CHECKED BY : JP

CONVEYANCE TO THE MAUNA LANI WWTP

JPE developed three preliminary route alternatives for conveying sewage from Puakō to the Mauna Lani WWTP. Each route is shown conceptually in Appendix B. In general, all three routes follow a similar path along Puakō Beach Drive, stretching from 69-1532 Puakō Beach Drive (near the Puakō ramp and loading dock parcel) to 69-2014 Puakō Beach Drive (near the Paniau end of the road). The primary difference between the routes is the diameter of the force main, which ranges from four to six inches. Consideration was made to include a connection from the public restrooms at Holoholokai Beach Park. The Waialea Bay Area is not part of the initial phase of this project, although connecting it in the future was considered during the planning of all three routes.

The construction drawings from the recent Department of Water Supply water main project were used to conceptualize the layout of the new sanitary force main and the proposed sewer laterals to each property. A copy of these drawings are included in Appendix C to provide details of the planned connections within the residential area of Puakō Beach Drive. Drawing Sheet C-5, at the end of Appendix C, provides further details for the lateral connections and their extensions to the right-of-way.

There are four types of laterals: short-single, short-double, long-single, and long-double. A "short" lateral refers to situations where the residence is on the same side of the street as the force main, while a "long" lateral is used when the residence is on the opposite side. A "single" lateral serves one household, and a "double" lateral serves two households. When feasible, double laterals are preferred for their cost efficiency in serving two homes with one lateral.

Additionally, the abandoned 8" diameter water line along Puakō Beach Drive could be repurposed as a casing pipe for the proposed 4" and 6" diameter sanitary force main. This reuse will help minimize disruptions along Puakō Beach Drive during construction and reduce overall construction costs. Finally, based upon early feedback from PFR, an option to run parallel pressure lines down each side of the road was investigated. This concept could work hydraulically and also eliminate the lateral road crossings. However, this options raises a number of concerns including: proximity to the electrical poles, existing right-of-way encroachments and damage crossing every driveway.

Route 1

Route 1 is the most straightforward option due to its direct path. The pressurized sewer lines from both directions converge near 69-1745 Puakō Beach Dr., where there is a reserved opening between the homes to allow the transmission portion of the force main to begin. From there, the force main will wind its way uphill towards the WWTP. The route passes through State of Hawaii conservation land and a large parcel owned by Ti Capital Management, LLC, before reaching Ho'ohana Street. The proposed force main then continues a short distance along Ho'ohana before reaching the WWTP entrance.

This route involves frequent changes in direction, particularly near Ho'ohana St. For the purposes of this preliminary analysis, the route follows an existing dirt road on the property. Early coordination with the relevant landowners for each alternative is essential to ensure a smooth and efficient process.

Engaging with the landowners at the outset allows for the identification of potential issues, such as access restrictions, easement requirements, or concerns about the impact on their property. It also provides an opportunity to establish clear communication, address any questions or objections, and negotiate any necessary agreements or permissions.

Route 2

Route 2 is the longest alternative, and it is likely to generate the least controversy, as the force main remains close to a roadway and within the presumed right-of-way for most of its length. In this option, the sewage is directed toward the north end of Puakō, where it continues up Puakō Beach Drive towards the highway before turning onto the Ho’ohana Street road lot. The force main will then continue along Ho’ohana all the way to the WWTP entrance. Early coordination with the relevant land owners to determine exact location near the highway is critical.

Route 3

Route 3 heads in the opposite direction from Route 2, toward the resort area on the south side of Puakō. Starting at Paniau Beach Park, the force main would pass through State of Hawaii lands leased by DHL Mahi Property Company. From there, it would continue along Holoholokai Beach Park Road and then wrap around the perimeter of the resort property eventually reaching the approximate location of the existing force main within the resort area. Whether the proposed connects to the existing force main or just follows it to the WWTP needs to be determined.

While this route may provide an alternative path, it could raise concerns due to construction disruption within the resort area as well as proximity to the Puakō Petroglyph Archaeological Preserve. Once again, early coordination with all relevant parties is critical.

Appendix D includes the estimated cost opinion for the three potential routes from Puakō to the Mauna Lani WWTP. The preliminary estimated construction costs for each route are outlined in the Table 3 below:

Route	Estimate
1	\$7,788,195
2	\$9,112,460
3	\$7,331,025

Table 3: Puakō Low Pressure Sanitary Force Main Costs

These estimated costs reflect the construction expenses for the force main but do not include detailed design engineering, engineering support during construction, legal fees, administrative costs, permitting, expenses for any necessary easements, individual property work, or additional contingency costs. At this stage design costs can be approximated as 10% of the construction costs. The costs for each lot will need to be determined separately for each parcel.

It is important to note that any estimate of construction costs is never a firm price. The project costs presented in this memorandum are just an estimate, and not an overly conservative estimate. PFR and all parties involved in the project should consider the possibility of much higher prices. A good example is the new water line project recently completed in Puakō. There were six contractors that bid. The results of the bid varied greatly and were: 1) \$5.8M, 2) \$6.1M, 3) \$7.1M, 4) \$7.3M, 5) \$8.7M, and 6) \$10.1M. The project could have easily been a \$7.1M project (or 22% more expensive) if just the bottom two bidders were not involved.

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Appendix A

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Orenco Prelos® 1000 Processor

Applications

Orenco's Prelos 1000 Processor provides complete, integrated storage, filtration, and pumping of wastewater for on-lot portions of Prelos Sewer systems and other pressurized liquid-only sewers or dispersal systems.

General

The Prelos Processor is the core of the Prelos Sewer System: an innovative technology based on 40 years of proven sewer solutions. The tank stores and passively treats solid waste, while the patent-pending pump vault and filter separate and pump liquid effluent.*

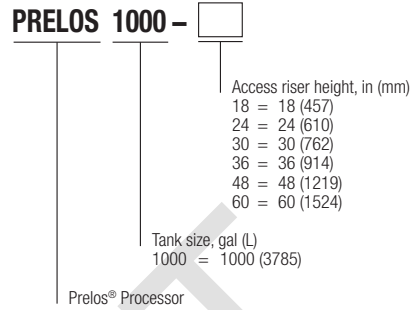
All Prelos 1000 Processors install as a unit, to reduce errors. The 30in (750mm) diameter access riser provides easy access to the tank interior, and the passively self-cleaning filter can be removed without removing the pump vault, pump, or discharge assembly, simplifying O&M and keeping related costs down.

* Tank covered under United States Patent #10,392,281

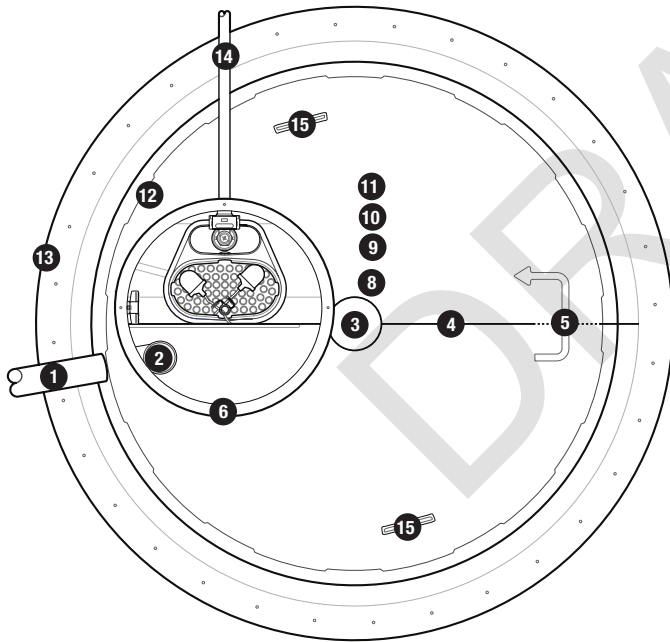
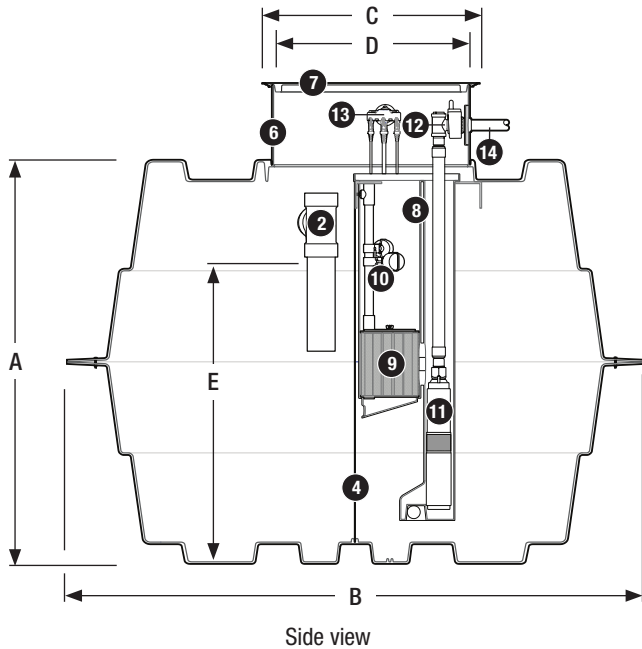
Standard Model

PRELOS1000-18, PRELOS1000-24, PRELOS1000-30, PRELOS1000-36, PRELOS1000-48, PRELOS1000-60

Product Code Diagram



The Prelos 1000 Processor offers complete, integrated storage and pumping of wastewater in a simple, effective package.



- | | | |
|------------------------------|---------------------------|------------------------|
| 1. Inlet | 6. Access riser | 11. Pump |
| 2. Inlet tee | 7. Access lid | 12. Discharge assembly |
| 3. Support column | 8. Pump vault | 13. ClickTight™ |
| 4. Baffle wall (full-length) | 9. Biotube® filter | 14. Discharge |
| 5. Baffle pass-through | 10. Float switch assembly | 15. Lifting bracket |

Tank, Riser, and Lid

The Prelos 1000 Processor's meander-style tank has a patented design for superior performance. It's tough, impact resistant, and light enough to install with small equipment. The single 30in (750mm) access riser and access lid are designed to provide strong, secure access to components inside of the Prelos 1000 Processor.

Materials of Construction

Access lid	Fiber-reinforced polymer (FRP), structural foam
Access lid hardware	Stainless steel
Access riser	FRP
Inlet and inlet tee	ABS
Baffle wall	ABS
Support column	PVC, ABS
Tank body	DCPD

Dimensions

A	Tank height, in (mm)	61 (1549)
B	Tank outside diameter, in (mm)	96 (2438)
C	Lid outside diameter, in (mm)	33 (838)
D	Riser inside diameter, in (mm)	29.5 (749)
E	Depth, nominal operating volume, in (mm)	48 (1219)
	Tank nominal operating volume, gal (L)	1000 (3785)
	Tank total volume, gal (L)	1220 (4618)
	Average volume at operating depth, gal/in (L/mm)	20 (3)
	Prelos Processor weight, nominal, lbs (kg)	550-640 (250-290)

Pump Vault

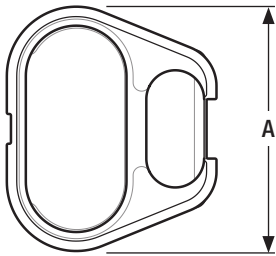
The Prelos 1000 Processor's patent-pending pump vault is designed to be passively self cleaning for reduced maintenance and service needs, with no need to remove the vault from the processor for cleaning.

Materials of Construction

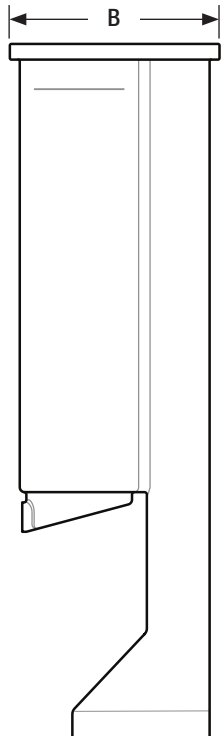
Vault body	Polyethylene
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Vault Dimensions in (mm)

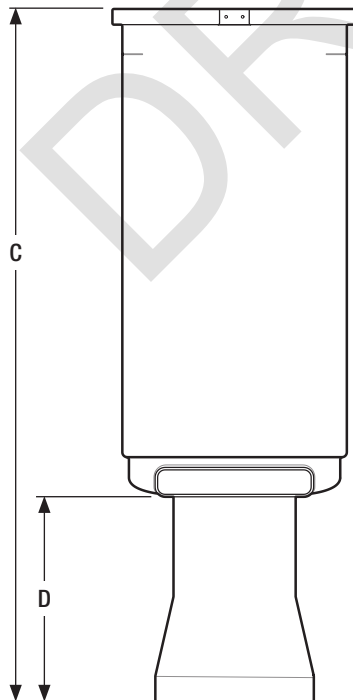
A	18.5 (470)
B	16.0 (406)
C	52.5 (1334)
D	15.75 (400)



Prelos pump vault, top view



Prelos pump vault, side-cutaway view



Prelos pump vault, front view

Biotube Effluent Filter

The Prelos 1000 Processor's Biotube effluent filter is designed for effective filtration of effluent and passive self cleaning for long maintenance cycle intervals.

Materials of Construction

End plates	DCPD
Filter tubes	Polypropylene
Handle assembly	Sch. 40 PVC
Screws	Stainless steel

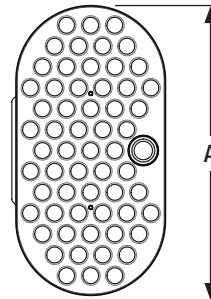
Dimensions in (mm)

A	16.5 (419)
B	10.0 (254)

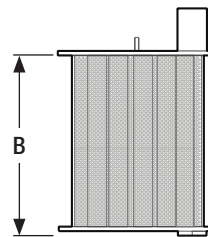
Performance

Biotube mesh opening, in (mm)*	0.125 (3)
Total filter flow area, ft ² (m ²)	4.0 (0.37)
Total filter surface area, ft ² (m ²)	14.0 (1.3)

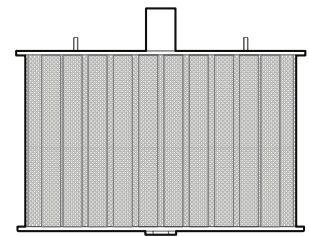
*0.062in (1.6mm) filter mesh available



Biotube filter cartridge, top view



Biotube filter cartridge, side view



Biotube filter cartridge, front view

4in (100mm) Effluent Pump

Pumps used in Prelos 1000 Processors are Orenco's PF-Series pumps. They're field serviceable with common tools and, in internal testing, have a minimum 24hr run-dry capability (liquid end) with no deterioration in pump life or performance. These pumps are equipped with Type SOOW 600V power cords (suitable for Class I, Division 1 and 2 applications); they also meet UL requirements and are CSA certified to US and Canadian safety standards for effluent pumps.

Materials of Construction

Connector	Glass-filled thermoplastic, silicone
Diffusers	Glass-filled PPO
Discharge	Glass-filled polypropylene
Discharge bearing	Engineered thermoplastic (PEEK)
Impellers	Acetal
Intake screens	Polypropylene
Lubricant	Deionized water, propylene glycol
Suction connection, drive shaft, coupling, shell	Stainless steel

Specifications

Nominal flow, gpm (L/sec)	10 (0.6)
Length, in (mm)	23 (584)
Weight, lb (kg)	26 (12)
Discharge, in (nominal)	1.25
Impellers	6

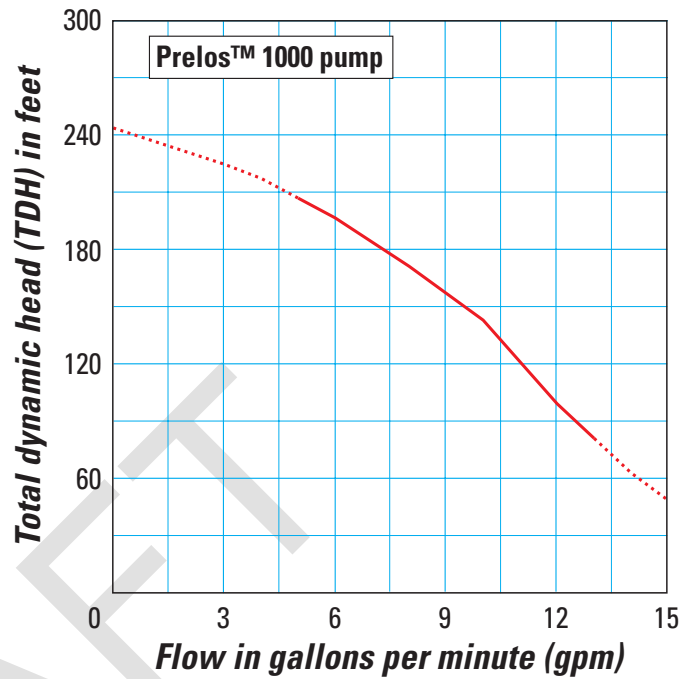
Performance

hp (kW)	0.5 (0.37)
Design flow amps	12.7
Rated cycles/day	300
Minimum liquid level, in (mm)*	16 (406)

* Minimum liquid level is for a single pump installed in a pump vault.

Pump Curve

This graph shows the pump's performance range and the relationship between flow (gpm) and pressure (TDH).



HDA-Series Discharge Assembly

Discharge assemblies used in Prelos 1000 Processors are designed for durability and ease of maintenance.

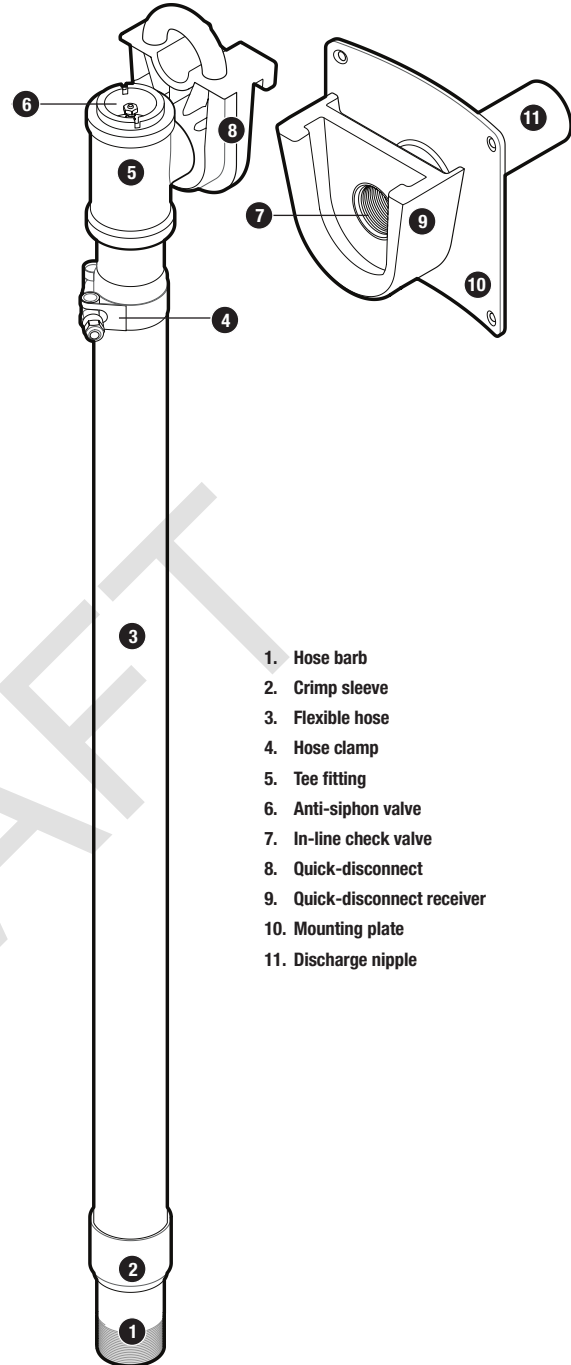
Materials of Construction

Anti-siphon valve	Sch. 80 PVC, EPDM, stainless steel
Discharge nipple	Sch. 80 PVC
Flexible hose	Reinforced EPDM
Flow control disc	Sch. 80 PVC
Hose fittings, tee fitting, mounting screws	Stainless steel
In-line check valve	Sch. 80 PVC, EPDM, stainless steel
Mounting plate	ABS
Quick-disconnect	Glass-filled thermoplastic

Working Pressures and Dimensions

Unit working pressure, psi (kPa)	150 (1034)
Height, mounting plate, in (mm)	7 (178)
Width, mounting plate, in (mm)	7 (178)
Diameter, discharge nipple, in*	1.25
Diameter, flow control disc orifice, in (mm)	0.25 (6.35)

* Contact your Orenco distributor about fittings to connect discharge assemblies to metric-sized piping.



HDA-Series discharge assembly

Float Switches

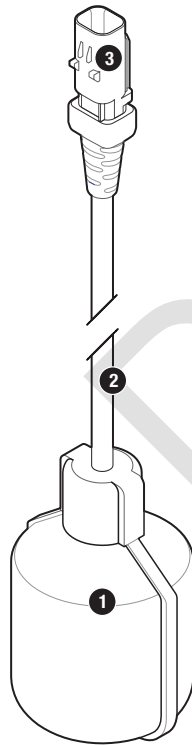
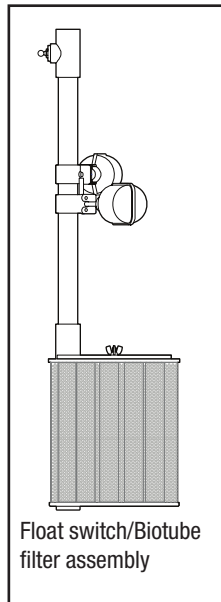
Float switches used in Prelos 1000 Processors are UL listed and CSA certified for use in water or sewage. To simplify accessing and servicing, the float switch assembly has been incorporated into the Biotube filter handle.

Materials of Construction

ClickTight connector	Glass-filled thermoplastic, silicone
Float collar	ABS
Float cord	Flexible, 2 conductor (UL, CSA, SJOW; CPE cord jacket with EPDM insulated conductors)
Float housing	Impact-resistant, noncorrosive polypropylene for use in liquids up to 140°F (60°C)

Float Switch Specifications

Float	State	Type
P	Normally open	Mechanical



1. Float switch
2. Float switch cord
3. Float switch connector

ClickTight mechanical float switch

ClickTight

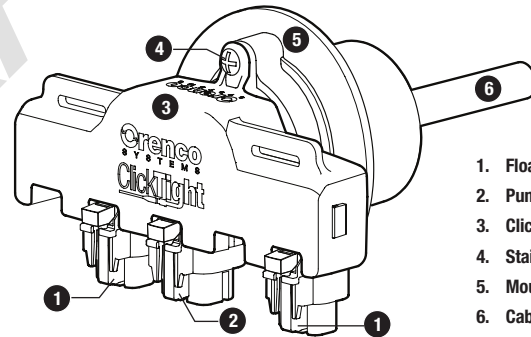
Orenco's ClickTight provides secure, moisture-resistant cable connections between the pump, float switches, and control panel in the Prelos 1000 Processor. ClickTight is UL listed for the US and Canada.

Materials of Construction

Cable	PVC/nylon, annealed copper; Type TC
Connectors	Glass-filled thermoplastic, silicone
Fastener	Stainless steel
Housing	ABS
O-ring	Buna-N
Potting compound	Urethane

Specifications

Cable rating	14AWG; 3 conductor; UL TC-ER 600V (pump) 18AWG; 2-8 conductor; UL TC-ER 600V (float)
Float switch connectors	double-pole
Pump connector	triple-pole
Maximum cable length, ft (m)	62 (19)



1. Float input connector
2. Pump input connector
3. ClickTight housing
4. Stainless steel fastener
5. Mounting flange
6. Cable

ClickTight

S1HR Control Panel

The Prelos 1000 Processor uses Orenco's S1HR control panel, which is ideal for Prelos Sewers and other effluent sewer applications.

Materials of Construction

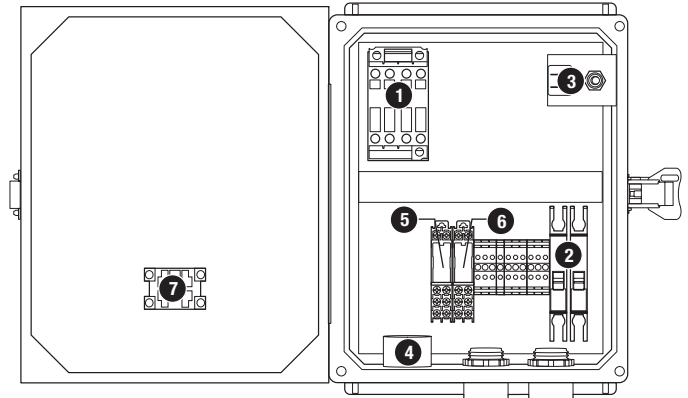
Enclosure	UV-resistant fiberglass, UL Type 4X
Hinges	Stainless steel

Dimensions, in (mm)

Height	11.5 (292)
Width	9.3 (236)
Depth	5.4 (137)

Specifications

Panel ratings	120VAC, 1hp (0.75kW), 16A, single-phase, 60Hz
Motor-start contactor	16FLA, 1hp (0.75kW), 60Hz; 2.5 million cycles at FLA
Circuit breakers	120VAC, 10A, single-pole (control) 120VAC, 20A, single-pole (pump)
Toggle switch	Single-pole, double-throw HOA switch
Audio alarm	95dB at 24in (610mm), warble-tone sound; gasketed, UL Type 4X (IP 66)
Redundant high-on relay	120VAC, DIN rail mounted; provides a secondary pump-on signal during high-level conditions
Audio alarm silence relay	120VAC, automatic reset, DIN rail mount
Visual alarm	7/8in (22mm) diameter red lens, "push-to-silence," 120VAC LED, UL Type 4X

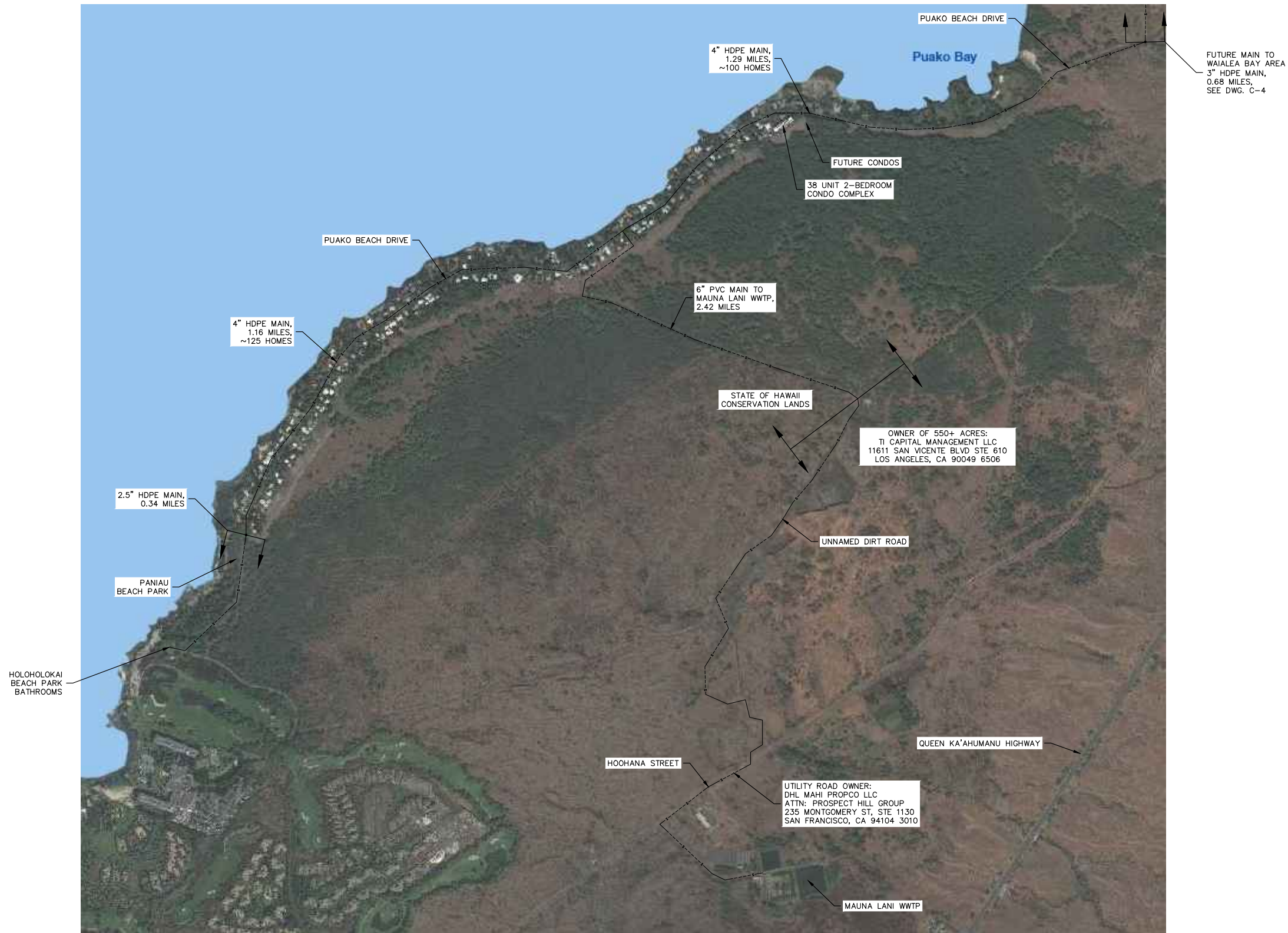


S1HR control panel

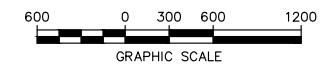
1. Motor-start contactor
2. Circuit breakers
3. Toggle switch
4. Audio alarm
5. Redundant high-on relay
6. Audio alarm silence relay
7. Visual alarm

Appendix B

DRAFT



PLAN
SCALE: 1" = 600'



P.O. BOX 551751
KAPAAU, HI 96755

JAMES M. PEDERSEN
LICENSE EXPIRATION DATE: 04/30/2026
THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION AND
CONSTRUCTION OF THIS WILL
BE UNDER MY OBSERVATION.

PUAKO FOR REEFS
WASTEWATER INFRASTRUCTURE PRELIMINARY ENGINEERING
 SITE PLAN
 ROUTE 1

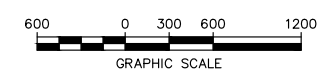
ISSUED DRAWINGS:

REVIEWED BY:	EGT	JPE JOB NUMBER: 24-121
DRAWN BY:	EGT	
DESIGN BY:	JMP	
DATE:	2025-01-31	
SCALE:	AS NOTED	

DRAWING NO.:
C-1
DRAFT
1 OF 4



PLAN
SCALE: 1" = 600'



P.O. BOX 551751
KAPAAU, HI 96755

JAMES M. PEDERSEN
LICENSE EXPIRATION DATE: 04/30/2026
THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION AND
CONSTRUCTION OF THIS WILL
BE UNDER MY OBSERVATION.

PUAKO FOR REEFS
WASTEWATER INFRASTRUCTURE PRELIMINARY ENGINEERING
 SITE PLAN
 ROUTE 2

ISSUED DRAWINGS:	

REVIEWED BY:	EGT	JPE JOB NUMBER: 24-121
DRAWN BY:	EGT	
DESIGN BY:	JMP	
DATE:	2025-01-31	
SCALE:	AS NOTED	

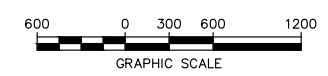
DRAWING NO.:
C-2
DRAFT

2 OF 4



FUTURE MAIN TO
WAIALEA BAY AREA
3" HDPE MAIN,
0.68 MILES,
SEE DWG. C-4

PLAN
SCALE: 1" = 600'



P.O. BOX 551751
KAPAAU, HI 96755

JAMES M. PEDERSEN
LICENSE EXPIRATION DATE: 04/30/2026

THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION AND
CONSTRUCTION OF THIS WILL
BE UNDER MY OBSERVATION.

PUAKO FOR REEFS
WASTEWATER INFRASTRUCTURE PRELIMINARY ENGINEERING
 SITE PLAN
 ROUTE 3

ISSUED DRAWINGS:	

REVIEWED BY:	EGT	JPE JOB NUMBER: 24-121
DRAWN BY:	EGT	
DESIGN BY:	JMP	
DATE:	2025-01-31	
SCALE:	AS NOTED	

DRAWING NO.:
C-3
DRAFT

3 OF 4



P.O. BOX 551751
KAPAAU, HI 96755

JAMES M. PEDERSEN
LICENSE EXPIRATION DATE: 04/30/2028

THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION AND
CONSTRUCTION OF THIS WILL
BE UNDER MY OBSERVATION.

PUAKO FOR REEFS
WASTEWATER INFRASTRUCTURE PRELIMINARY ENGINEERING
WAIALEA PLAN

ISSUED DRAWINGS:

REVIEWED BY:	EGT
DRAWN BY:	EGT
DESIGN BY:	JMP
DATE:	2025-01-31
SCALE:	AS NOTED

DRAWING NO.:

C-4

DRAFT

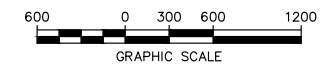
4 OF 4



**WAIALEA PLAN
FOR C-1 AND C-3 ROUTES**
SCALE: 1" = 600'



**WAIALEA PLAN
FOR C-2 ROUTE**
SCALE: 1" = 600'



Appendix C

DRAFT

Appendix D

DRAFT

PUAKO LOW PRESSURE SANITARY FORCE MAIN

A General		Route 1				Route 2				Route 3			
1	Lump Sum for Mobilization / Demobilization; Cleanup and Finishing, etc.	LS		\$30,000.00		LS		\$30,000.00		LS		\$30,000.00	
2	Lump Sum for Best Management Practices and National Pollutant Discharge (NPDES) Permit	LS		\$100,000.00		LS		\$100,000.00		LS		\$100,000.00	
Total				\$130,000.00				\$130,000.00				\$130,000.00	
B Earthwork, Roadway, and Site Work													
3	Scarify Existing A.C. Pavement 3" Depth and Resurface with 3" Thick A.C. (State Mix IV) for County Roads (inclusive of all road preparation, striping, and other related work.	29,300	Sq. Yd.	\$105.00	\$3,076,500.00	29,300	Sq. Yd.	\$105.00	\$3,076,500.00	29,300	Sq. Yd.	\$105.00	\$3,076,500.00
4	Scarify Existing A.C. Pavement 3" Depth and Resurface with 3" Thick A.C. Road Paving/Restoration for State Roads (inclusive of all road preparation, base course, compaction, striping, and other related work.	0	Sq. Yd.	\$120.00	\$0.00	0	Sq. Yd.	\$120.00	\$0.00	0	Sq. Yd.	\$120.00	\$0.00
Total				\$3,076,500.00				\$3,076,500.00				\$3,076,500.00	
C Pressure Sewer Piping and Appurtenances													
5	6" PVC C900; inclusive of all installation, traffic control, Geotech fabric, saw cutting, excavation, CLSM, and temporary roadway patching	12,778	L.F.	\$175.00	\$2,236,150.00	21,701	L.F.	\$175.00	\$3,797,675.00	8,554	L.F.	\$225.00	\$1,924,650.00
6	6" 22.5 deg, 45 deg, 90 deg Bend	12	Each	\$2,000.00	\$24,000.00	24	Each	\$2,000.00	\$48,000.00	10	Each	\$2,000.00	\$20,000.00
7	Connection at WWTP	1	LS	\$10,000.00	\$10,000.00	1	LS	\$10,000.00	\$10,000.00	0	LS	\$10,000.00	\$0.00
8	4" PVC C900; inclusive of all installation, traffic control, Geotech fabric, saw cutting, excavation, CLSM, and temporary roadway patching	4,636	L.F.	\$170.00	\$788,120.00	3,158	L.F.	\$170.00	\$536,860.00	4,559	L.F.	\$170.00	\$775,030.00
9	4" 22.5 deg, 45 deg Bend, 90 deg Bend	4	Each	\$1,500.00	\$6,000.00	4	Each	\$1,500.00	\$6,000.00	4	Each	\$1,500.00	\$6,000.00
10	4" Gate Valve and Vault	4	Each	\$10,000.00	\$40,000.00	4	Each	\$10,000.00	\$40,000.00	4	Each	\$10,000.00	\$40,000.00
11	1" Air Relief Valve unit and Box in place complete	4	Each	\$5,000.00	\$20,000.00	2	Each	\$5,000.00	\$10,000.00	2	Each	\$5,000.00	\$10,000.00
12	2.5" PVC C900; inclusive of all installation, traffic control, Geotech fabric, saw cutting, excavation, CLSM, and temporary roadway patching	1,795	L.F.	\$135.00	\$242,325.00	1,795	L.F.	\$135.00	\$242,325.00	211	L.F.	\$135.00	\$28,485.00
13	2.5" 22.5 deg, 45 deg Bend, 90 deg Bend	3	Each	\$750.00	\$2,250.00	3	Each	\$750.00	\$2,250.00	3	Each	\$750.00	\$2,250.00

14	4" HDPE within abandoned water line; inclusive of all installation, fusing, traffic control, saw cutting, excavation, CLSM, and temporary roadway patching	8,317	L.F.	\$50.00	\$415,850.00	8,317	L.F.	\$50.00	\$415,850.00	3,054	L.F.	\$50.00	\$152,700.00
15	6" HDPE within abandoned water line; inclusive of all installation, fusing, traffic control, saw cutting, excavation, CLSM, and temporary roadway patching									5,263	L.F.	\$70.00	\$368,410.00
Total		\$3,784,695.00				\$5,108,960.00				\$3,327,525.00			
D	Lateral Work												
16	1.25" single service lateral - short, inclusive of excavation/backfill, pipe, fittings, sleeves/tapping, geotech fabric, CLSM, and all appurtenances, in place complete	43	Each	\$3,000.00	\$129,000.00	43	Each	\$3,000.00	\$129,000.00	43	Each	\$3,000.00	\$129,000.00
17	1.25" double service lateral - short, inclusive of excavation/backfill, pipe, fittings, sleeves/tapping, geotech fabric, CLSM, and all appurtenances, in place complete	26	Each	\$4,000.00	\$104,000.00	26	Each	\$4,000.00	\$104,000.00	26	Each	\$4,000.00	\$104,000.00
18	1.25" single service lateral-long crossing road and water line, inclusive of excavation/backfill, pipe, fittings, sleeves/tapping, geotech fabric, CLSM, and all appurtenances, in place complete	29	Each	\$6,000.00	\$174,000.00	29	Each	\$6,000.00	\$174,000.00	29	Each	\$6,000.00	\$174,000.00
19	1.25" double service lateral-long crossing road and water line, inclusive of excavation/backfill, pipe, fittings, sleeves/tapping, geotech fabric, CLSM, and all appurtenances, in place complete	27	Each	\$7,000.00	\$189,000.00	27	Each	\$7,000.00	\$189,000.00	27	Each	\$7,000.00	\$189,000.00
20	2" single service lateral - short, inclusive of excavation/backfill, pipe, fittings, sleeves/tapping, geotech fabric, CLSM, and all appurtenances, in place complete	1	Each	\$6,000.00	\$6,000.00	1	Each	\$6,000.00	\$6,000.00	1	Each	\$6,000.00	\$6,000.00
21	Encasing water line or lateral and sewer force main in concrete at crossings	65	Each	\$3,000.00	\$195,000.00	65	Each	\$3,000.00	\$195,000.00	65	Each	\$3,000.00	\$195,000.00
Total		\$797,000.00				\$797,000.00				\$797,000.00			
1-2	A. General	\$130,000.00				\$130,000.00				\$130,000.00			
3-4	B. Earthwork, Roadway, and Site Work	\$3,076,500.00				\$3,076,500.00				\$3,076,500.00			
5-15	C. Pressure Sewer Piping	\$3,784,695.00				\$5,108,960.00				\$3,327,525.00			
16-21	D. Lateral Work	\$797,000.00				\$797,000.00				\$797,000.00			
TOTAL BID		\$7,788,195.00				\$9,112,460.00				\$7,331,025.00			

EXHIBIT 9

Table 1
Proposed Puako Community Facilities District
CFD Bond Analysis Summary

<u>Project Assumptions</u>		
Construction Costs		\$9,100,000
Connection Costs	\$33,000 per house	\$6,930,000
Total Construction Costs (TECC)		\$16,030,000
Design and Survey	10% of TCC	\$1,603,000
Feasibility/EA		\$250,000
Legal Fees		\$50,000
Contingency	20% of TCC	\$3,206,000
Total Estimated Development Costs		\$21,139,000
<u>Bond Assumptions</u>		
Average Interest Rate		5.00%
Month of Issuance		SEP
Months of Principal/Interest Payments		MAR / SEP
Capitalized Interest (Months)		0
Bond Term (Years)		30.0
Reserve Fund as a % of Bond Issue		6.47%
Capitalized Interest as a % of Bond Issue		0.00%
Issuance Cost / Underwriter's Discount as a % of Bond Issue		4.00%
Annual % Increase in Special Tax		0.00%
<u>Bond Uses</u>		
Construction Costs Funded by Bonds		\$21,139,000
Reserve Fund		\$1,527,809
Capitalized Interest		\$0
Issuance Costs / Underwriter's Discount		\$944,450
Total		\$23,611,259
<u>CFD Special Taxes</u>		
Total Maximum Special Taxes Required		\$1,680,590
Total Households		210
Annual Special Tax (per Household)		\$8,003

Source: Goodwin Consulting Group, Inc.

4/21/2025



Proposal



The Kālainmoku Group
a communications and marketing firm



Proposal for:

Puakō for Reefs Stakeholder Engagement Proposal

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Page 12-15: Proposal

Page 16: Proposed Timeline

Page 17: Budget

Page 18-28: Past Performance
and Capabilities

Page 29: Mahalo



June 25, 2025

Karen Anderson
Karen.anderson@puako4reefs.org
206-724-155

Subject: Puakō for Reefs Stakeholder Engagement Proposal

Aloha e Karen,

The Kālainmoku Group (TKG) is pleased to present our proposal for Community Engagement and Media Relations Consulting to assist the coastal community of Puakō,

TKG is Native Hawaiian-owned and operated, and our approach is always community-driven.

We aim to communicate effectively with area stakeholders and build support within the community to create a fully sewerred system along the length of Puakō reef.

As a full-service advertising agency, TKG has experience in all aspects of marketing, communications, and community relations. We specialize in outreach to Native Hawaiian communities across the State of Hawai'i and beyond.

Our agency is a Native Hawaiian-owned, SBA 8(a) certified communications and professional services firm, equipped with the skills and capabilities necessary to perform all required tasks.

We are fully committed to ensuring the success of this project, utilizing every resource and relationship at our disposal.



John Aeto
President
The Kālainmoku Group

The Kālainmoku Group respectfully submits this proposal in response to the request for stakeholder engagement services in support of the Puakō for Reefs (PFR) initiative.

As a Native Hawaiian-owned communications and engagement firm with a proven record in environmental communications, cultural consultation, and complex community dialogue, our team is uniquely equipped to build consensus and advance this once-in-a-generation opportunity to restore the Puakō reef ecosystem.

Recognizing the urgency and sensitivity of this project, we will implement a culturally grounded and strategically phased engagement process rooted in face-to-face dialogue, transparent messaging, and trusted local relationships.

Our team brings decades of experience working with Hawai'i County, cultural practitioners, scientists, and grassroots leaders across Hawai'i Island.

We are skilled in translating complex policies into compelling narratives that mobilize support, clarify concerns, and empower residents to act in the best interest of their 'āina and kai.

This proposal outlines a four-phase work plan utilizing a budget of \$40,000 plus travel expenses over ten months.

- Phase 1: Coalition Building
- Phase 2: Promotion of the Coalition
- Phase 3: Stakeholder Engagement
- Phase 4: initiate the Petition

We are committed to supporting Puakō for Reefs in reducing community dissent below the 45% threshold and generating sustained county and community alignment through informed, inclusive, and values-based engagement.

Company Profile

Business Information
Services
Past Clients
Key Personnel

The Kālainmoku Group (TKG)

The Kālainmoku Group (TKG) is a Marketing and Communications firm located in Honolulu, Hawai'i.

Since 2011, TKG has provided public and private sector organizations with professional services including Marketing, Communications, Public Relations, Grassroots Engagement, Website Development, Graphic Design, Social Media and Event Coordination.

SAM Status: Native Hawaiian Organization SBA Small Disadvantaged Business

CAGE Code: 8M3N4

UEI: L6MLH3W7EV86

- **Advertising Agencies** - 541810
- **Public Relations Agencies** - 541820
- **Marketing Consulting** - 541613
- **Media Buying Agencies** - 541830
- **Motion Picture and Video Production** - 512110
- **Event Management** - 711320
- **Direct Mail Advertising** – 541860
- **Commercial Photography** - 541922
- **Graphic Design** – 541430
- **Research and Development in the Social Sciences and Humanities** – 541720
- **Administrative Management and General Management** – 541611
- Other professional, scientific, and technical services - 541990
- **Other Administrative Services** – 561110



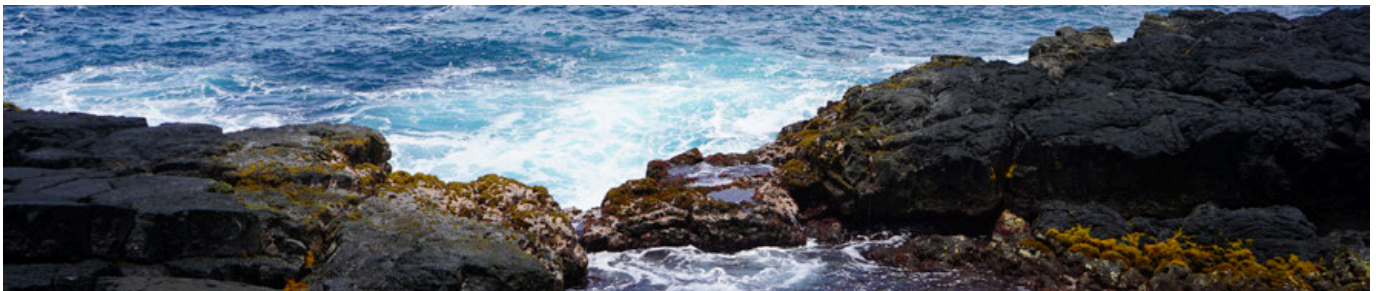
Corporate Address: 3005 Hoaloha Place Hon, HI 96817

Website: www.kalaimoku.com

Contact: John Aeto, President

Email: johnaeto@kalaimoku.com

Phone: 808-216-2386



The Kālainimoku Group (TKG)

From the time of Kamehameha the Great, the Kālainimoku played an integral role in the governance of his kingdom. Kamehameha's loyal and trusted regent, chief treasurer, chief counselor, commander in chief and supreme war leader during his rule was named Hu'euKālanimoku, a high chief from Hāna, Maui and an uncle to Kamehameha's wife, Ka'ahumanu.

His counsel and leadership aided Kamehameha significantly in successfully ruling a new unified Hawaiian kingdom fusing western practices with traditional Hawaiian customs.

Kālanimoku continued to counsel and advise Ka'ahumanu, Kamehameha II, Liholiho and the council of chiefs after the passing of Kamehameha.

He played a major role in dividing up the lands among the ali'i, thus the term kālai (carve) moku (island, district).

With respect to and in accordance with this traditional Hawaiian regency role that served our ali'i well, The Kālainimoku Group endeavors to aide and assist today's leaders and innovators to maximize their own potential and opportunities.

By providing the guidance and consultation to strategically manage and to facilitate a variety of projects, The Kālainimoku Group may serve as an invaluable adviser to ensure successful outcomes.

Established in 2011, The Kālainimoku Group (TKG) is full-service advertising agency and 8(a) designated company under the Small Business Administration (SBA) and owned by The Kālainimoku Foundation, a Native Hawaiian Organization (NHO) non-profit.



TKG's logo is a traditional Lei Niho Palaoa, a whale tooth pendant and symbol of Hawaiian rank. Hand drawn by artist Brook Kapukuniahī Parker it represents the firm's commitment to perpetuating Hawaiian culture and values

TKG comprehensive services include:

Marketing Strategy and Planning

Creative Services and Production

Media Buying

Community Engagement

Communications

Crisis Management

Public Relations

Website Development

Digital Marketing Solutions

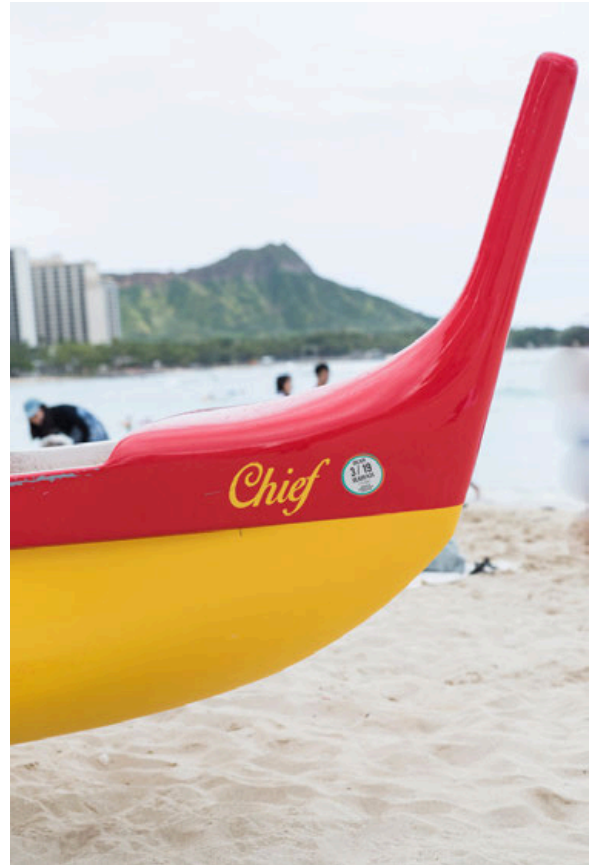
Custom Publication

Event Coordination and Production



TKG Current and Former Clients

U.S. Census Bureau
U.S. Department of the Interior - Office of Native
Hawaiian Relations
Kamehameha Schools
Office of Hawaiian Affairs
Native Hawaiian Roll Commission
Native Hawaiian Legal Corporation
Department of Hawaiian Home Lands
Hawai'i Tourism Authority
Hawai'i USA Federal Credit Union
Kapolei Chamber of Commerce
Ko Olina Resort Operator's Association
Kalihi Palama Health Center
Nānākuli Housing Corporation
Hawai'i Academy of Recording Arts
WaimeaValley
Papa Ola Lokahi
Hui No Ke Ola Pono
Honolulu Community College
National Kidney Foundation of Hawai'i
Kuakini Hospital
Shriners Hospital for Children
EK Fernandez Events
Hawaii State Department of Labor and Industrial
Relations
Hawai'i Conservation Alliance
Saint Louis School
Hawai'i Law Enforcement Memorial Foundation
Honolulu Community College
Hawai'i State Public Library System
Operative Plasterer's and Cement Mason's
International Association Local 630
Hawai'i State Public Library System



Team TKG

Organization and Management

The Kālainmoku Group (TKG) is a full-service advertising agency headquartered in Honolulu, Hawai'i. TKG assembles specialized teams through our customer-focused approach to deliver specific expertise and client solutions. Our tailored approach ensures that every campaign effectively engages and inspires the target audience.



John Aeto

PRESIDENT

John Aeto is the founder and President of The Kālainmoku Group (TKG) a Native Hawaiian Pacific Islanders (NHPI) communications firm. TKG was founded in 2011 to super serve the NHPI community in Hawaii, the Pacific and North America. TKG is considered the leading expert and only full-service communications firm that specializes in the NHPI community. In 2020, the US Census Bureau reported that the NHPI community was the fastest growing ethnic community in the US, with over 1.7 million to date across all 50 states.

Prior to TKG John spent over 25 years in the corporate world of Broadcast Radio in the Honolulu market working for KCCN/KINE Radio and Cox Broadcasting. Starting as an account executive in 1987 and exiting in 2010 as a General Manager. John was part of a small team that created the Hawaiian Radio Music Industry, an industry focused on the Buying and Political power of the Native Hawaiian community. John has been a leader and member of the Native Hawaiian community for all his life. Raised by his Hawaiian grandmother, a 13-year graduate of the Kamehameha schools. Graduate of Pa Kui a Holo, Center of Strategic sales and Halau Ke Kai o Kahiki – John has a unique blend of traditional and western education, fellowship and mentorships. John is also a Samoan family chief and received his tradition title and Pe'a (Full Body Tattoo) in 2013.

John currently the Chair of the Native Hawaiian Hospitality Association and on the board of Chamber of commerce of Hawaii, Friends of Ka Leo Hawaii, and Parkinson's Association. A founding board member of the Hawaii Bowl and the Diamond Head Basketball Tournament. Past board member of Hale Kipa, March of Dimes, Nā Hōkū Hanohano awards, Native Hawaiian Chamber of Commerce, Pacific Links Foundation, National Kidney Foundation of Hawaii, Senator Akaka OHIA foundation and many more. John knows Hawaii and the Native Hawaiian community like few do.

Team TKG

Strategy and Communications



Cedric Duarte

MANAGING
PARTNER

Cedric is a Honolulu based consultant and storyteller with a passion for Hawaiian culture and over 25 years of experience in marketing, sales, advertising, communications, and public relations. He has built successful marketing and communications campaigns for Native Hawaiian Serving organizations, Government entities, retailers, non-profits, and financial institutions. His specialties include project management, marketing strategy, communications, public relations, community engagement, and event organization. Cedric is a Board member with the Native Hawaiian Chamber of Commerce, President of the Kalihi Palama Hawaiian Civic Club and a Mamo Hawaii in the Royal Order of Kamehameha.



**Cyrus
Johnsen**

COMMUNICATIONS
DIRECTOR

Cyrus Johnsen has over 15 years of experience across the public and private sectors; he has built a strong reputation for leading strategic communications, advancing community-building efforts, and advocating for meaningful societal change. He has served on numerous community and corporate boards, earning recognition as a dedicated leader committed to uplifting Hawai'i's underserved populations. His expertise in developing and implementing organizational strategies to address social disparities reflects his lifelong dedication to creating equitable opportunities. A proud graduate of Kamehameha Schools Hawai'i, Cyrus holds a Bachelor of Arts in Political Science from the University of Hawai'i at Hilo. A Hilo native, he continues to serve his community with a focus on fostering collaboration and positive impact throughout the islands.



Ella Spett

PROJECT MANAGER

Ella Spett is a Honolulu-based project manager who supports strategic initiatives for Native Hawaiian organizations, communities, businesses, and government entities. Ella will soon graduate from the University of Hawai'i Shidler College of Business in May of 2025 with a Bachelor of Business Administration in International Business and Marketing. With a background in marketing and sales, Ella has completed several internships in project management, event organization, PR, digital marketing, communications, and professional sales. She is also an active member of the American Marketing Association (AMA) which helps her stay connected to the changing industry trends.

Proposal

**Account Management
Strategic Communications
Key Message Development
Community Engagement
Media Relations**

Community Engagement and Media Relations Consulting

Task: To educate and engage the Puakō community about the Cesspool, Septic, and sewer systems on their property and its future, Saving the Puakō Reef

Phase 1	Coalition Building
Phase 2	Promotion of the Coalition
Phase 3	Stakeholder Engagement
Phase 4	Initiate the Peition

Our engagement strategy is rooted in Native Hawaiian values of kuleana (responsibility), aloha ‘āina (love of the land), and mo’okū’auhau (lineage and continuity).

We recognize that Puakō’s future depends on collaboration across generations, landowners, and systems of governance.

Stakeholder Engagement Plan

Our engagement strategy is rooted in Native Hawaiian values of kuleana (responsibility), aloha ‘āina (love of the land), and mo’okū’auhau (lineage and continuity).

We recognize that Puakō’s future depends on collaboration across generations, landowners, and systems of governance.



Community Engagement

Key strategies include:

- Place-based storytelling: Use the “Wahi Pana” narrative of Puakō to remind residents of cultural and ecological interdependence.
- Community-led messaging: Identify and train a group of trusted messengers from within the community.
- Face-to-face trust building: Conduct small talk story sessions alongside larger facilitated discussions.
- Transparency in process: Communicate how the CFD works, what people are committing to, and what the benefits are over time.
- Media alignment: Match internal engagement with external messaging to unify community and political discourse.

The Kālaïmoku Group proposes a phased engagement strategy over a ten-month period, structured around four integrated phases. This workplan ensures that both immediate needs (i.e., building support within Puakō to reduce dissent) and long-term objectives (i.e., mobilizing external stakeholders and decision-makers) are addressed.

Phase 1: Coalition Building (July - Sept 2025)

Goal: Identify and connect with trusted community voices including non-profits, community leaders, and cultural practitioners to educate them on the situation

- Research, outreach, and agreement
- Develop key messages and establish persuasive narrative
- Develop www.savehawaiireefs.org as a home base of information (URL has already been reserved)
- Identify influential voices (trusted messengers) to serve as community ambassadors.

Target Audiences:

- Hotel Managers
- Environmental Groups
- Native Hawaiian Leaders
- Kama'āina
- Ako'ako'a Reef Restoration Program
- Coral Reef Alliance (CORAL)
- Kuleana Coral Restoration
- Hawaii Marine Animal Response (HMAR)
- Hawaii wildlife Fund
- Reef Guardians Hawaii
- Nature Conservancy in Hawaii
- Hawaii Conservation Alliance
- American Reef Coalition

Phase 2: Promotion of the Coalition (Sept – Nov 2025)

Goal: Take the coalition public to let the broader community know about the issue and the groups who are in support.

- Develop and manage a marketing and publicity campaign
- Campaign to include media relations, advertising, social media tactics including channels affiliated with www.savehawaiireefs.org
- Media Budget: \$10,000 for Radio and Newspaper
- Media Relations: Create Press Releases and deploy Social Media Ads

Phase 3: Stakeholder Outreach (Dec 2025-Feb 2026)

Goal: Inform and unify the Puakō community, reduce uncertainty, and improve understanding of the CFD process.

- Meeting one on one with (15) kupuna/long-term residents of the community

Phase 4: Petition (March 2026)

Goal: Get 25% of Puako residents to sign petition.

- Plan and facilitate (1) large-scale community meeting with strong visual storytelling and culturally grounded presentations.
- Develop online petition housed at www.savehawaiireefs.org

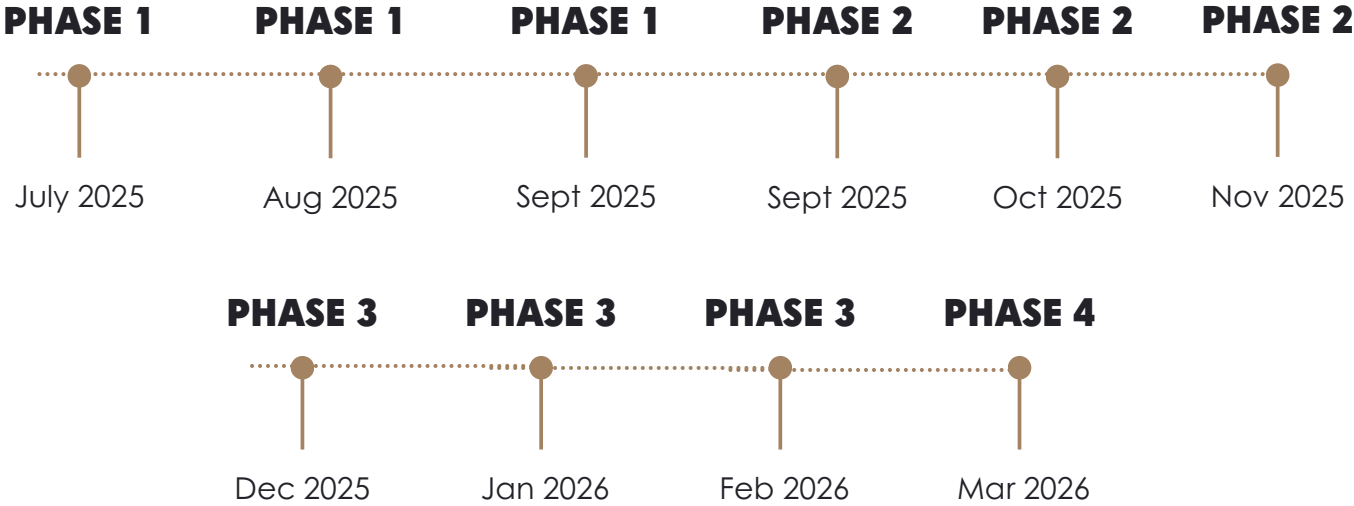
Proposed Timeline

Phase 1: Coalition Building June – Sept 2025

Phase 2: Promotion of the Coalition Sept– Nov 2025

Phase 3: Stakeholder Outreach Dec 2025 - Feb 2026

Phase 4: Petition Mar 2026



Proposed budget

Phase 1: Coalition Building

Total: \$14,000 + tax

Item Description Cost

- 60x hours at \$200 = \$12,000 (includes campaign development)
- Travel = \$2,000

Phase 2: Promote the Coalition

Total: \$19,000 + tax

Item Description Cost

- Media Relations
- Advertising
- Social Media

Phase 3: Stakeholder Engagement

Total: \$17,000

Item Description Cost

- 15x one on one meetings over 5 days with 2x TKG staff at 8x hours a day

Phase 4: Initiate the Petition

Total: \$6,000

- 1x Community Meeting with (3) TKG Staff members

TOTAL: \$56,000

- All fees are subject to Hawai'i State General Excise Tax of 4.712%
- Contract may be cancelled by either party with thirty days notice
- 50% deposit, balance upon completion of each task

Past Performance and Capability Examples

**Marketing
Advertising
Outreach**

Marketing (National)

CLIENT: U.S. Census Bureau (subcontractor)

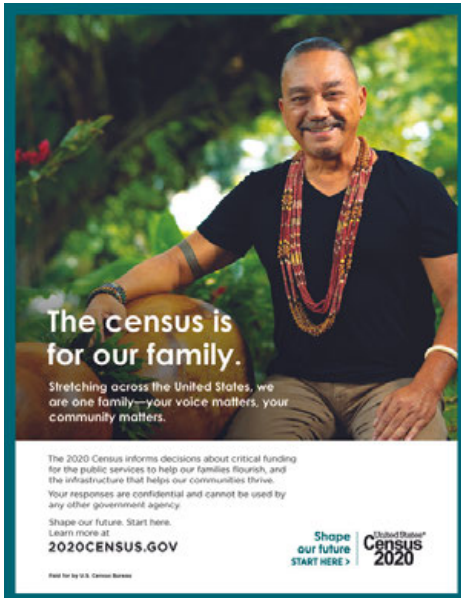
PROJECT: 2020 Census

TASK: To encourage participation in 2020 Census by Native Hawaiians and Pacific Islanders

Research, Strategy, Complete Creative Development, Media Planning, Media Buying, Media Relations, and Campaign Evaluation

TKG's "Trusted Voices" campaign features leaders and notable figures from the Native Hawaiian Pacific Islander community encouraging participation in the 2020 Census.

Display Ad Original



- Managed all aspects of engaging with the Native Hawaiian Pacific Islander(NHPI) community across all 50 states.
- Managed all creative budgets, storyboards, bids, and quotes for talent and production teams.
- Built and executed a “bottom up” media approach for the NHPI market.
- Planned and Placed a national media budget of \$2.3M including digital, print, outdoor, and broadcast.
- Developed and implemented earned, shared, and owned media campaigns targeting NHPI in all 50 states. Managed media relations and press conferences. Recruited all media influencers.
- Tested Census perceptions, engagement tactics, and creative design with the NHPI community.

Television Ad Original

<https://youtu.be/7xZ-tTtasU>



Marketing (National)

CLIENT: U.S. Department of Health and Human Services (subcontractor)

PROJECT: Covid-19 Vaccination “We Can Do This”

TASK: To encourage Covid-19 Vaccination among Native Hawaiians and Pacific Islanders

Strategic Partnerships, Creative Development, Media Planning, Media Buying, Media Relations, and Campaign Evaluation

Postcard Mailer



The Omicron variant is spreading more easily and quicker than the original virus.

Department of Hawaiian Home Lands
P.O. Box 1979
Honolulu, HI 96806

PRESORTED
FIRST-CLASS MAIL
U.S. POSTAGE
PAID
Honolulu, HI
Permit No. 583

ORIGINAL COVID-19 STRAIN

DELTA VARIANT

OMICRON VARIANT

Vaccines and boosters protect you from hospitalizations, severe infections, and death
source: cdc.gov/coronavirus

As COVID-19 spread across the nation, the U.S. Department of Health and Human Services (HHS) urgently needed to educate Americans about prevention measures.

TKG worked with our prime contractor to launch the HHS “We Can Do This” COVID-19 Public Education Campaign to build people’s confidence in COVID-19 vaccines.

The total integrated multichannel communications campaign delivered more than 65 billion paid media impressions and 17 billion earned media impressions, with communications highly tailored to diverse audiences.

Earned Media

20 **Ask a Kauka - Hō'ola Wāhine**

“Māhala a Nā Kauka, the Association of Native Hawaiian Physicians, share valuable medical information via their Ask-A-Kauka webinars. This is an excerpt taken from a special Webinar Edition of Ask-A-Kauka that first aired on September 15 featuring Dr. Auni Soan and Dr. Rosalie Teasdale, both of whom specialize in obstetrics and gynecology. View the complete webinar at: <https://m.facebook.com/askahawaiianka/>”

Do you recommend the COVID-19 vaccine for pregnant women?

Dr. Rosalie Soan: “Yes, I absolutely do. I encourage people to talk to their health care providers but, yes, the American College of Obstetricians and Gynecologists, and the Society for Maternal-Fetal Medicine strongly recommend the COVID vaccine during pregnancy at any moment.”

“We are strongly recommending this because the data shows that pregnant women who get COVID are at much higher risk for complications. There are higher rates of pre-term birth, hospitalizations, and death. Anecdotal mid-level we started seeing pregnant women with COVID coming into the hospitals having a hard time breathing. Some ended up getting really, really sick. They require high amounts of oxygen and if we get to the point where we have to intubate to help her breathe, many times we need to deliver the baby at that point.”

“All of the women hospitalized during pregnancy have been unvaccinated. I’ve been an OB/GYN for 29 years here in Hawaii. I’ve seen more pregnant women intubated and on ventilators in the last two months than I have in all the rest of my years as an OB/GYN combined.”

Dr. Rosalie Teasdale: “I’m definitely recommending it. I got vaccinated when I was pregnant. I was 16 weeks. I’m definitely going to get my booster since I’m still breastfeeding.”

“When I got my vaccine there weren’t as many studies, but just looking at the science behind it I realized there was no way it could cause a birth defect. I really wasn’t scared to take the vaccine because it had a new science – the creation of vaccines – we’ve been doing this for many years. But now we actually have studies. About 35,000 women in studies have gotten a vaccine (while pregnant) and we haven’t seen any side effects.”

“On the flip side – with COVID and pregnancy – we’re seeing prolonged hospitalizations, oxygen requirements, increased ICU care, ventilation support, we’re having to deliver these women pre-term. And all have been unvaccinated.”

“If you’re pregnant and sick with COVID you’re four times more likely to require ventilation and the risk of death is 70% higher. There’s increased risk of pre-eclampsia, miscarriage, pre-term birth, c-sections, and blood clots because you’ll be in bed unable to move.”

Some are worried that there may be an impact on their fertility or ability to carry children in the future. What message would you have for these types of concerns?

Dr. Rosalie Soan: “This myth of it [the vaccine] affecting fertility started when the epidemiologist from Germany suggested that the spike protein on the surface of the virus had some similarity to a placental protein and that the vaccine might then lead to binding of that protein affecting fertility somehow. But the idea of that doesn’t really make sense because if the COVID-19 spike protein could cause infertility then the COVID-19 virus itself would also be causing infertility. Of the hundreds of thousands of patients now who have gotten the vaccine there is zero evidence that the vaccine affects fertility. In my own practice I’ve had patients get pregnant immediately after getting the vaccine.”

Is it safe to get the vaccine while breastfeeding?

Dr. Rosalie Teasdale: “Yes, it is. Anything safe in pregnancy is going to be safe in breastfeeding. And you’re going to have the added benefit of potentially giving your baby antibodies as well as it is highly recommended. We haven’t seen any side effects at this point. We can confidently say it looks very safe.”

I'M VACCINATED

Walter and Loreita Rife
Primary School & Co. Ltd.

“Mālama Nā 'Ōhānani! Loreita and I have been vaccinated.”

Dr. Likali Kame 'Oshiro
Professor, Hawaii State University, Honolulu, Hawaii

“I am vaccinated and safe to return to my classroom. From that moment forward, I will be vaccinated. This is a great day for me and my family. We have had to take care of our community and the needs of all who are vaccinated. The safety and confidence we see. I am vaccinated because we need to protect our kids and take them home, and in doing so, assure that our 'ohana and 'āhau will continue and thrive.”

Walter and Loreita Rife
Kali, HI, 96806

In the campaign’s first year, COVID-19 vaccine hesitancy in the U.S. adult population decreased from 19% to 3%.

An estimated 40 million Americans moved from vaccine hesitant to vaccine confident or vaccinated.

Marketing (State of Hawai'i)

CLIENT: Hawai'i State Department of Labor & Industrial Relations (Prime)

PROJECT: QUEST Workforce Development Grant

TASK: To encourage participation in a new Paid Internship program

Strategy, Creative Development, Media Planning, Media Placement, Website, Social Media, and Campaign Evaluation

Display Ad Original



- Target Audience: Students, Low-income, Long-term unemployed, Native Hawaiians; Pacific Islanders; Senior citizens (55 years and older); Minority ethnic groups; Veterans; Persons with a disability; Women; and Individuals possessing low basic skills
- Management of all creative budgets, storyboards, bids and quotes for talent and production teams.
- Development of Display and Video assets
- Development of Media Buying Plan
- Purchased of annual Television, Outdoor, Digital, and Radio advertising
- Garnered an immediate increase in applications for the Paid Internship Program

Contact:

Leila Shar
Acting Program Officer
Department of Labor and Industrial Relations
Workforce Development Division
808-586-9169 | leila.n.shar@hawaii.gov

Television :30



<https://youtu.be/axwgDL3ZQ1M?feature=shared>

Television :30



<https://youtu.be/TOvNNTimiT8?feature=shared>

Communications

CLIENT: U.S. Department of the Interior (prime)

PROJECT: Office of Native Hawaiian Relations

TASK: To encourage Grant application by Native Hawaiian Organizations

Strategic Partnerships, Strategic Communications Planning and Execution, Website maintenance, Grant Technical Assistance

The Office of Native Hawaiian Relations (ONHR), formally established by Congress in 2004, discharges responsibilities related to the Native Hawaiian people and assists with the Department’s activities in Hawai‘i.

ONHR’s mission is to serve as a liaison with the Native Hawaiian Community—and the Department and its bureaus and offices—on issues affecting Hawai‘i. ONHR also seeks to fulfill the U.S. Government’s responsibilities to effectuate and implement the special political and legal relationship between the United States and the Native Hawaiian Community, and continue the process of reconciliation with the Native Hawaiian people.



ONHR's Lisa Oshiro on KITV's Island Life Live



ONHR's Stanton Enomoto speaking at SCHHA Convention

TKG assisted with the development of a strategic communications plan as well as oversaw outreach and grant technical assistance for the new \$20 Million Kapapahulu Climate Resiliency Program funded by the 2022 Inflation Reduction Act.

ONHR received over 50 applications for projects totaling over \$80 million, with over half of the recipients applying for federal funding for the first time.

Digital Advertising (State of Hawai'i)

CLIENT: Honolulu Community College (Prime)

PROJECT: Fall Semester Applications

TASK: To encourage applications to Honolulu Community College programs

Strategy, Media Planning, Media Placement, and Campaign Evaluation

- Target Audience: Traditionally underrepresented in higher education: Native Hawaiians, Pacific Islanders, First-Generation, Adult Learners with no College, Females in Trades, and economically disadvantaged.
- High school graduates of nearby high schools
- Populations interested in switching careers to a trade
- Development of Media Strategy
- Development and Placement of Media Buying Plan
- Garnered an immediate increase in college applications

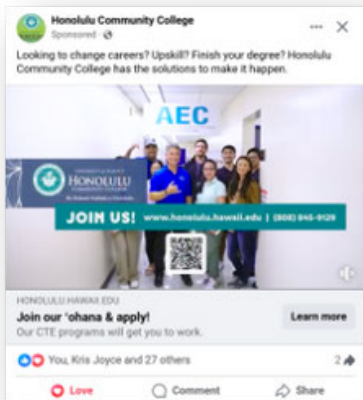
TACTICS: SEM/Paid Search, Facebook Display, Facebook Reels, Instagram Display, Instagram Reels, TikTok Reels, YouTube Shorts.

Contact:

Iris Greges
Marketing Coordinator
Honolulu Community College
808-845-9429 | igreges@hawaii.edu



YouTube Shorts



Facebook Display

The Kālaïmoku Group (TKG)



TikTok Reels

Research and Community Relations

CLIENT: Various

PROJECT: Focus Groups, Community Meetings

TASK: To gather information or disseminate information to the community

TKG has successfully conducted community meetings across the islands, demonstrating expertise in coordinating all logistical aspects. This includes managing room reservations, sending invitations, arranging audio/visual equipment, ensuring security, providing hospitality, and facilitating effective meetings.



Focus Group



Community Meeting

Complex Video Production

CLIENT: U.S. Census Bureau (subcontractor)

PROJECT: 2020 Census

TASK: To encourage participation in 2020 Census by Native Hawaiians and Pacific Islanders

TKG boasts extensive expertise in video production, with decades of experience spanning feature films, television shows, commercials, and documentaries. We have a proven track record of creating high-quality, culturally resonant content. Our team excels at all phases of video production, from meticulous pre-production planning and script development to dynamic on-site filming and sophisticated post-production editing.

We also have a deep understanding of Hawaiian culture, coupled with our technical proficiency, enables us to deliver projects that are not only visually stunning but also culturally authentic and impactful.

Filmed on-location at iconic venues across the United States, TKG's powerful rendition of "This is Me" performed by Native Hawaiian and Pacific Islander artists and dancers from across the country was designed to invite and inspire their community to be seen, heard and counted in the 2020 Census.

Viral Music Video

<https://www.youtube.com/watch?v=GWCySrYxov0>



Earned Media

CLIENT: Various

PROJECT: Press Conferences, Media Relations, Video News Release

TASK: To place clients in appropriate media outlets for maximum exposure

TKG has delivered numerous press events and media inclusions for its clients. In addition to media pitches, TKG will often produce and submit complete Video News releases and Electronic Press Kits on behalf of our clients.



Press Conference



Television - Live Interview



Television - In Studio Interview



Print Feature



Radio - In Studio



Electronic Press Kit

Experiential Event Production

CLIENT: Various

PROJECT: Concerts, Fundraisers, Block Parties, Parades, Festivals

TASK: To encourage participation in 2020 Census by Native Hawaiians and Pacific Islanders

Honolulu Night Market:

TKG produced several editions of the Honolulu Night Market for Kamehameha Schools from 2017-2020 in the Our Kaka'ako urban district on O'ahu.

The events featured over 60 food and shopping vendors alongside live entertainment, DJs, and sponsors. Crowds of nearly 10,000 attended these quarterly events.



The complete event production included planning, coordination, logistics, and sponsorship fulfillment.

May Day Waikīkī:

TKG produced six May Day Waikīkī events for the Hawai'i Tourism Authority.

The events honored the legendary Beach Boys and Watermen of Waikīkī with live concert on the beach livestreamed to the world.



The complete event production included planning, coordination, booking, logistics, and a multi-camera livestream of the event.

Custom Publication

CLIENT: Pacific Basin Communications

PROJECT: Mana Magazine

TASK: To create a high-quality magazine for the Native Hawaiian Community

Using a full suite of writing and editing service, TKG published 23 issues of Mana Magazine, a printed magazine targeting Native Hawaiians and Pacific Islanders.

Mana Magazine was mailed to roughly 30,000 subscribers in partnership with Native Hawaiian serving organizations and appeared on newsstands throughout the state of Hawaii.

TKG oversaw the entire production of each book including story development, writing, editing, photography, graphic design, and publicity.





The Kālainmoku Group

a communications and marketing firm

www.kalaimoku.com

Mahalo for the opportunity to provide you this proposal.

Approvals

John Aeto
President
The Kālainmoku Group

Date

Karen Anderson
Puakō For Reefs

Date



USDA Meeting Notes

March 14, 2025

I had a very productive meeting today with Lennie Okano-Kendricks of USDA where we discussed the following:

1. Funding Availability. Funds for the water and wastewater programs under Lennie do not seem affected by the federal cuts, so we are encouraged to apply.
2. USDA Application Process. 1) Lennie suggested we have her review the draft Preliminary Engineering Report (PER) to determine the environmental requirements-- i.e., whether the project can get by with a lesser Environmental Report (through a categorical exclusion process) or a full EA. Her review would also confirm whether the PER meets USDA requirements. She has worked with Jim Pederson, so Jim should be familiar with the requirements (I will share a sample PER format when I receive from Lennie). 2) Once we know the environmental scope requirements, we can start the environmental review process. Lennie would be involved in the environmental process if consultations are required with the State Historical Preservation Division (SHPD) or USFW. 3) We can start the application process after completion of the PER and EA, or concurrently. The application is done online ("RD Apply"). Since the County would be the borrower, the County would provide USDA a letter naming the lead person in the County who would sign-off (e.g., DEM Director) and authorize PFR to fill in the application. Lennie can provide a sample letter. If we decide to pursue this USDA loan, we should perhaps have a draft of that letter ready when we meet with the County department heads.
3. Project Scope. USDA funding can be used for components of the project on private land, provided the County would be responsible for those components (e.g., easement granted to the County). Lennie would confirm the eligibility upon review of the draft PER.
4. Loan Security. Lennie is familiar with improvement districts but not CFDs. When I explained that the County would be responsible for the collections through the property tax billing and enforcement of defaults through a lien on each property, she seemed assured that the CFD would be ok. But she will confirm with her counsel when we have more details on the bond.
5. Interim Construction Financing. USDA funding can be made available for construction if the County can demonstrate that it cannot get interim financing. The USDA funding would close after bids are issued and contract awarded. If the contract amount is within 20% of the bid estimate, the County can seek a supplemental loan to cover the overage. The loan amount would include a 10% contingency to cover potential cost overruns. If there is a balance remaining in the contingency upon completion, the leftover is paid to principal. If interim construction financing is available, the USDA loan would close based on the final cost upon completion.
6. Construction Contract. Regardless whether we close before or after completion of construction, the construction documents need to follow the EJCDC (Engineers Joint Contract Documents Committee) format adapted to incorporate the County's general conditions. The County may already have a format that merges the EJCDC with County requirements from the Lono Kona project, or DWS for sure has a merged format that USDA has previously approved.